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PRODUCT ENGINEERING

GRAW-HILL WEEKLY OF DESIGN, RESEARCH AND DEVELOPMENT · AUGUST 29, 1960

the european engineer talks...

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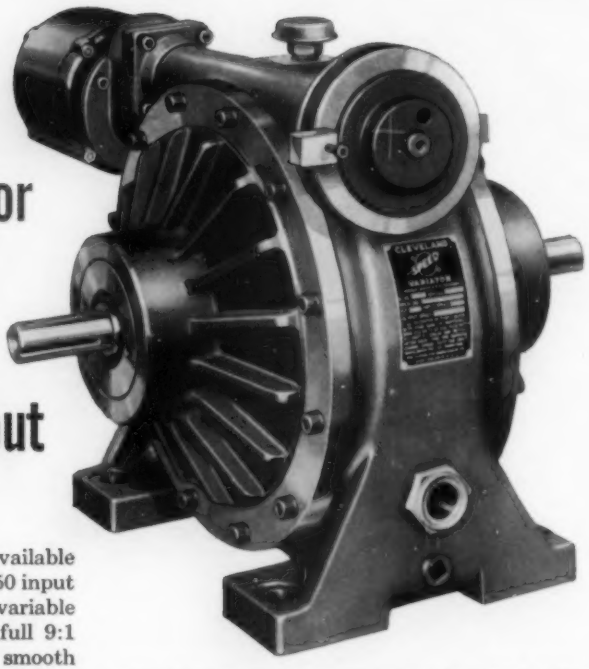
Cleveland Speed Variator is the Best Answer to *Precision Control* of Variable Speed Output



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- Ample bearing support for overhung pulleys on both input and output shafts

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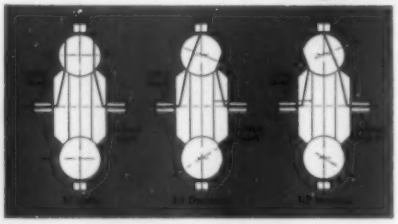

Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with the drive discs. Relative shaft speeds are adjusted by changing position of axles on which the balls rotate.

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PRODUCT ENGINEERING

McGRAW-HILL WEEKLY OF DESIGN, RESEARCH AND DEVELOPMENT

August 29, 1960 Vol. 31, No. 35

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INTERESTING TO NOTE

EDITOR TANGERMAN (left) and PE's Milan editor, Gene di Raimondo (right) talk with auto stylist Pinin Farina in Turin. The car is a Farina body on a Cadillac chassis, exhibited at the Paris Salon. Its top is all plastic, with an internal sliding shade.

Five jet-stream hours from New York is London where Editor Tangerman began a tightly scheduled 40-day fact-finding trip. During that time he interviewed a hundred men, mostly engineers, from 50 organizations, in seven countries. The Common Market was the core of this running dialog which is highlighted in "The European Engineer Talks . . ." beginning on page 61.

Differences? There are many. The European business day starts at 7:30 or 8, breaks sharply at noon, takes up at a progressively later hour afterwards as you go south. In Italy, it's three o'clock before they return to work after the heavy noon meal. But they go on until 7 o'clock, and nobody eats supper until about 9 pm.

Then there's the conversation. At a "business" dinner (noon) in Europe, there's little shop talk–it's time to live a little, to talk of the opera, or art, or philosophy. Business can resume later. In Sweden, Denmark, England, the lunch in the dining room is followed by coffee and cigars on a terrace, balcony or in an executive lounge.

But at the desk, the European executive is all business. His bureau (office) door is customarily closed. He is courteous but not casual, and his assistants maintain a respectful distinction. Cigars and several kinds of cigarets are immediately offered to visitors, and the door is closed–to be left this way. Such a subject as the Common Market is not to be discussed lightly, so the visitor is a bit uncomfortable for a half hour or longer while he establishes the basis for the interview–with no help from the host.

Then, if rapport is established, the host will talk, choosing his words carefully. He may talk for an hour or longer, so the usual interview is longer than its American counterpart. Then there's the ceremonial tour, followed by another cigar and brandy or coffee. There is time to discuss, to digest, to question. The attitude is that tomorrow will take care of tomorrow's problems. Even in research, the pace is deliberate, a divide-and-conquer approach rather than the American massive attack. "We in the United States don't solve research problems; we trample them to death," an American engineer told Edward Bowyer, head of the Society of British Aircraft Constructors.

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INTERESTING TO NOTE continued

Oil Is Where You Find It

There once was a song containing the passage "love makes the world go 'round." From a strictly engineering viewpoint it wouldn't be "love"; it would be oil. Lubrication (see page 54) is just one application for this black liquid that has caused as much explorer's fever as all the gold rushes combined.

One of the most unusual methods of oil prospecting is being used by a pair of Texans—they count bugs. Oil industry scientists have known for some time that there exist species of microbes that live on natural petroleum products. What the two Texans have done is to figure a way of determining the chances of an oil deposit by counting the number of microscopic organisms in any given area.

A sample of earth is taken from the area under investigation. The scientists time the speed with which the oil microbes consume the petroleum gas in the sample and start to work on a fresh supply added in the laboratory. The more bacteria there are, the sooner they begin to consume the new gas. Once the number of oil bugs is determined, the Texans say they can estimate the probability of there being any oil in the sample area.

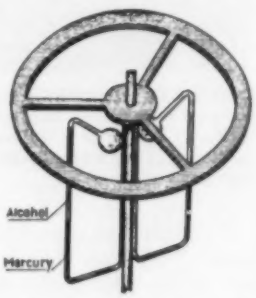
Other new techniques of finding oil have been discovered in recent years. Oilmen believe there is a relationship between petroleum deposits and radioactivity, and some of them go prospecting with a Geiger counter. Another group—the geochemists—believes oil can be spotted by chemically analyzing samples of earth near the surface for hydrocarbon content.

But of all the modern devices, few have the flavor of the microbe count. It has taken a century for the oilman, plagued by insects in swamp and field, to get "bugs" working for him. The fact still remains, however, that there's no sure way of knowing there's oil below without drilling.

Sea Trials

Navigation at sea during the 18th century presented interesting problems to explorers—chronometers were inaccurate, so it was almost impossible to pinpoint an exact position at sea. The solution to the problem required the design of an instrument whose operation would not be affected by a ship's motion. The eminent physicist Christian Huygens had once suggested making the end of a pendulum travel in a cycloidally curved path to ensure the regular oscillations. To compensate for the sea's motion, he suggested various ways to suspend the pendulum. Clock-makers tried these various suggestions, but to no avail.

Frenchman Pierre Leroy tried a new escapement, but it was so difficult to construct, it never received much prominence. Its principle left the balance wheel free during the greater part of its movement. In his search for a marine chronometer, he developed the first thermally compensated balance wheel. Leroy fixed two thin, curved thermometers, each containing mercury and alcohol, to either side of the staff of the balance wheel. The mercury is pushed towards the staff as the temperature rises. He obtained regular oscillations by using two spiral springs wound in opposite directions.



When he took his complicated chronometer to sea, it gave excellent results; however, a dispute with a rival caused Leroy to retire from the field. Although he was the first to expound the principles on which marine chronometers were later constructed, none of the actual solutions which he used was adopted. —Benedict A Leerburger Jr

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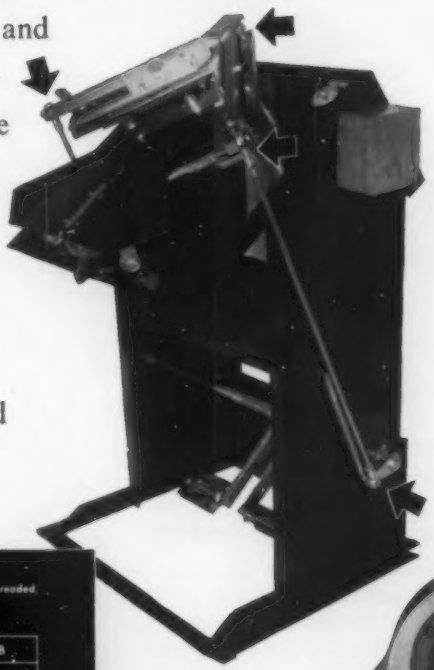
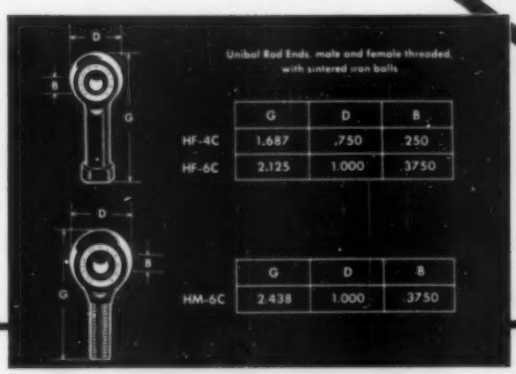
This is the Collar Shaping and Pressing Machine made by the Reece Folding Machine Company, which is a low-priced, manually operated device used in the shirt trade for shaping and pressing collars after they are sewed together, but before being attached to the shirt.





	G	D	B
HF-4C	1.687	.750	.250
HF-6C	2.125	1.000	.3750

	G	D	B
HM-6C	2.438	1.000	.3750

Unibal Rod Ends are used in five places, and were chosen for some carefully-thought-out reasons.

- *Unibal ball joints lower the machining and assembly cost.* A male Unibal is used at the fulcrum of the triangular pressing lever at top center. This allows the pressing plates to be easily lined up with the mating surface without expensive machining to close tolerances.
- *Long wearing qualities reduce replacement costs.* Reece says, "We have been using Unibal rod ends in our machines since 1947, and as far as we know, none have had to be replaced because of wear.
- *Solve design problems economically.* The use of Unibal "gets us out of some tough design problems quite economically, simplifies co-operating parts and makes final assembly easier."
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DEVELOPMENTS TO WATCH . . .

Molybdenum panels stand 3000 F

Molybdenum structural elements are being evaluated under NASA sponsorship, and first reports are very good. A number of resistance-welded sandwich panels have been made and tested at 3000 F and, says NASA, panel strength "corresponds closely to that of molybdenum itself." The tests also indicate the effectiveness of recently developed protective coatings. However, coatings tended to fail at the edges of the thin panel-cover sheets. Major emphasis is therefore being placed on improvement of coating-application systems.

Tubeless voltmeter measures static electricity

A voltmeter that uses a vibrating reed condenser in place of vacuum tubes to measure static charges in the 0- to 5000-volt range has been designed in Switzerland, will be marketed here by Fabrionics Corp., Huntington, Long Island, NY.

The unit consists of an 8-range voltmeter with built-in synchronous motor, four different electrodes for various operating conditions, and a portable recorder. Heart of the system is the condenser itself, a 2-plate unit so arranged that one plate is made to oscillate at constant frequency by an exciter coil. The condenser's ac output is amplified and rectified so the polarity and magnitude of the input voltage can be read from a galvanometer. Input resistance is on the order of 10^{15} ohms to eliminate zero-point fluctuations.

First applications will be in the textile-processing field, and special electrodes have been designed for measurements on moving fabrics and for measuring surface conductivity at resistances to 10^{15} ohms.

Rotating cylinders switch high voltages

A rotary switch to interrupt circuits "on the order of thousands of volts" has been designed by a Los Alamos engineer. It's a unit in which air is replaced by a solid dielectric in the form of insulating shell. This separates the contacts of the switch in the "off" position, and allows them to mate (by spring action) in the "on" position.

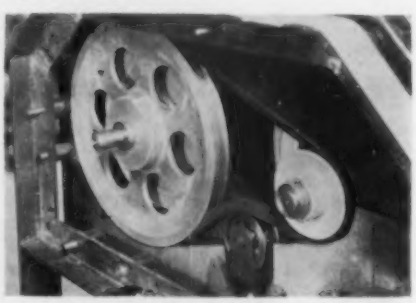
The smallest and simplest form of the switch is cylindrical in shape, with two concentric shells. An aperture in the movable inner one allows the contacts to mate.

Atomic Energy Commission says the device is adaptable to low- as well as high-voltage circuits. It holds the patent on the device, and is ready to grant nonexclusive, royalty-free licenses for production and sale.

New speed-change mechanism provides wide operating range

A selector system that can pick up any one of a series of V-belts to throw in any preselected speed on a machine tool has been designed by Tungum Ltd of Gloucestershire, England.

Essentially, the device is a hydraulically or pneumatically operated valve-and-piston system which acts much like a clutch. When the control lever is set to desired speed, air or fluid is admitted to a piston and an idler is pushed up, engaging a groove in the selected belt, tightening it against its pulley, and thus bringing it into operation. (The other belts spring clear, being retained by a guard or shroud in a neutral position.)

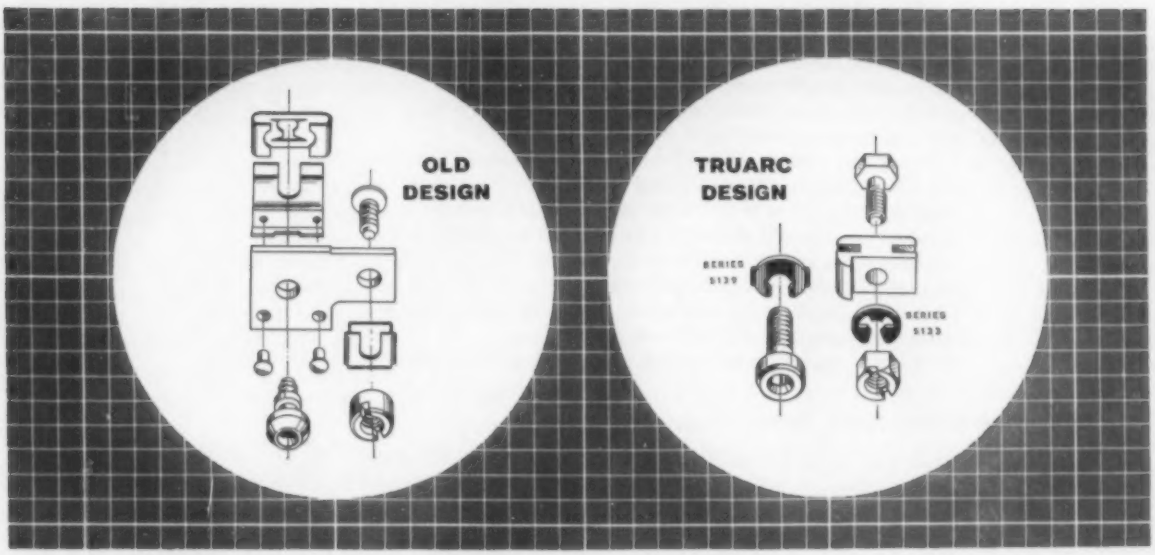


PULLEY-AND-BELT SYSTEM for speed selection features an idler (foreground) which moves up as shown to select desired operating pair.

Tungum engineers claim the device can also be applied to remote control of conveyors and automatic transfer systems. The basic design can be varied to provide ultra-slow speeds, reversing drives, and other special requirements.

continued, p 8

How Truarc rings simplified design and saved $60 per 1000 units



Look behind this big saving in parts on the auto contact points made by Shurhit Products Inc., Waukegan, Illinois. One Truarc Ring replaced an expensive special purpose fastener. Another eliminated a clip and retaining plate which were 4 times more expensive and difficult to assemble. A third replaced a special purpose nut.

Equally important, besides simplifying and improving design, Shurhit reduced the over-all size of its auto points by ¼" and reduced assembly time by 50%. *Savings: $60 per 1000 units.* Let Truarc Rings help cut your basic manufacturing cost by simplifying design and making assembly faster and easier. Rings often contribute highly saleable compactness as well!

WHY TRUARC RINGS BELONG ON YOUR PRODUCT

They offer a simple and effective way to locate, retain or lock components in place. They fit into grooves inside bores and housings. They work as effectively on shafts or studs (some without grooves).

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Powder combinations give better insulation

Fine aluminum particles can reduce the apparent thermal conductivity of aerogel silica powders at low temperature, says W. H. Power of Monsanto. Reduction of more than 60% in thermal conductivity can be achieved with just 10% aluminum powder; 50% aluminum cuts the apparent *k* to little more than 10% of its normal value, giving a factor of only 2.8 microwatts/cm. Another promising combination he reported to the Cryogenic Engineering Conference: aerogel powder and lamp black. Its *k*-factor: 7.6. Monsanto emphasizes that these materials are still being explored. No new aerogel insulation is being offered commercially at this time.

Engineers tell limits of solar converters

Silicon solar cells will never be much more than 15% efficient, several speakers at last week's AIEE Space Symposium indicated.

Other new energy-conversion devices (fuel cells, for instance) promise much higher efficiencies. But silicon cells still rate consideration, and much can be done to bring performance closer to the theoretical limit (19 to 20%) by closer attention to panel design, surface reflectance, and other characteristics that influence over-all output.

Solar cells are still pretty costly, too, as indicated by these figures, cited by Lockheed and Convair representatives:

Present-day silicon cells, providing a conversion efficiency of about 10% at 85 F, cost about $2000/sq ft. Individual cells are 1 x 2 x 0.4 cm and deliver power at costs ranging from $700 to $6000/watt. It is reasonable to hope, they say, that the minimum figure can be brought down to $300/watt as fabrication techniques improve.

That's still a lot of money, even for earth satellites. On the other hand, where power requirements are lower, the price of small solar units is not prohibitive. Hoffman Electronics, for instance, now offers 1-by-2½-in. solar modules in small quantities (primarily for researchers and hobbyists) at prices from $16 to $22.40. In bright sunlight these 5-cell, plastic-encased units will supply up to 42 milliamp at 2 v (84 milliwatts).

This new film made from foam

Another new film, for insulation as well as such conventional applications as decoration and packaging, is being made from foamed plastic. This one is a styrene material (foamed polyethylene films have previously been available); and, says Monsanto's Chemical Div, it's cheap enough to compete with paper. It is said to have excellent resistance to water and greases. Monsanto is ready to supply it in thicknesses of 0.010 to 0.030 in., widths to 36 in., at prices ranging from $4 to $7/thousand sq ft. (Note: for information on foamed polethylene film, see *PE*—Aug 25 '58, p 5.)

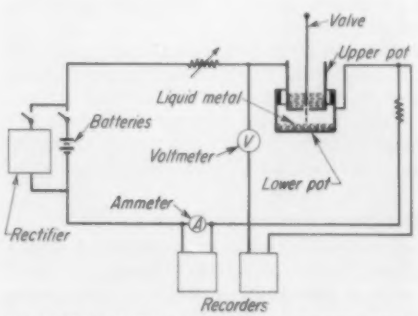
Liquid metal switches high-amp currents

Large-current, low-voltage loads can be switched safely and inexpensively, says K. A. Ahmad of IBM, by using a column of molten metal to make and break contact between pot-type electrodes.

In one design (see diagram), a maximum current density of 1400 amps/cm² was achieved without arcing.

The metal used was a lead-tin-bismuth-cadmium alloy which melts at 160 F, has an electrical conductivity close to that of lead itself, and shows excellent resistance to oxidation.

In this unit, the column length is 1 cm; velocity at orifice, 76.2 cm/sec, and at point of contact, 98.7 cm/sec. The reservoir pots are both made of copper. —ARG



IN LIQUID-METAL SWITCH, molten alloy flows from upper pot through circular orifice to lower pot, establishing first current contact. Then pots are moved together until they meet. This reduces length of the column, and its resistance practically to zero, and shunts current from operating unit.

WHAT'S HAPPENING IN RESEARCH . . .

Fibers point way to whisker use in metals

By imbedding ultrafine high-strength tungsten wires in copper, NASA says it has produced composites showing tensile strengths on the order of 120,000 psi, compared with 30,000 for the copper itself. Furthermore, says NASA, this can be accomplished with no more than 35% by volume of the tungsten, and equally good results are obtained with very short-length fibers as with long ones.

This last finding is particularly important since it opens the way for utilization of ultrastrong metal fiber "whiskers" in developing new metallurgical constructions.

As NASA points out, if the full strength of these single-crystal metal filaments could be utilized, it would be possible to produce materials "so strong that most structural components could be greatly reduced in size and weight and still maintain their structural integrity. Rocket and other space components could be lightened, and payloads could be increased significantly."

The trouble is, such fiber "whiskers" cannot now be made—on any scale at least—except in very short lengths. The recent findings indicate that it will be possible to replace the strengthening wires with the phenomenally strong but very short whiskers and produce materials of unbelievably high strength.

ASTM seeks improved tests for acoustic fatigue

There is still no satisfactory test for acoustical fatigue, Wright Air Development Div representatives told an ASTM committee meeting. Equipment for acoustical-fatigue testing is being developed but, right now, "the only reliable test is one that takes place in the actual service environment—behind an operating jet engine."

Sirens, air-blast exciters, and voice coil-modulated air jets are all under test. Miniature jet engines are used too. But new approaches are needed.

Until such tests are available and more is known about the whole subject, W. J. Trapp of WADD says, increasing damping is about the best approach to combating acoustical fatigue. He and B. J. Lazan of U of Minnesota told the meeting they believed much could be done by taking fuller advantage of the damping ability available within the structure itself: the rubbing at contact surfaces, the hysteresis of materials, and the shear in adhesives used for bonding. (*PE*—Oct 26 '59, p 35).

On the theoretical side, M. A. Wilkov of Penn State discussed a possible mechanism by which such failures occur: motion of dislocations, resulting in formation of cavities along glide lines, and eventual growth of these cavities into microcracks. What actually causes nucleation of these cavities is still an open question, though, and one that is being pursued at Penn State with the aid of electron microscope studies of carbon replicas.

Resistance thermometer claimed accurate to 1560 F

A platinum resistance thermometer with a resistance-temperature characteristic that is "practically linear to 1560 F" is claimed by Degussa Research Laboratories, Hanau, West Germany.

The unit consists of a coil form made of sintered clay and wound with fine platinum wire, and has supply leads of a rhodium-platinum alloy. A special ceramic insulation, claimed to have excellent shock resistance, replaces the conventional glass sheath and serves to attack the supply leads.

At 840 F, Degussa reports, the resistance of the unit is 264.16 ohms, rising only to 389.23 ohms at 1560 F. Room-temperature resistance is about 115 ohms.

Man-made element will last 212,000 years

A long-lived isotope of the unstable element technetium, found in atomic "wastes" (PE—Jan. 18, p 9), is now being produced in substantial quantities, AEC reports.

Technectium, element 43 in the periodic table, stands right next to molybdenum, but it's never been found in nature and was never available in the pre-atomic age. Now, 19 different isotopes of the element have been produced; and one, Tc^{99}, with a half-life of 2.12×10^5 years, has been found in quantity in spent nuclear reactor fuels. Already more than 3 lb of the isotope have been recovered, and "large-scale" production is under way.

brief . . .

Research goals for dual-purpose fuels are outlined by Esso Research as it begins work on a new Air Force project to develop fuels that can serve as heat sinks and heat-transfer media as well as a source of power (*PE*—Apr 4, p 6). Says Esso: Such fuels must have a capacity to absorb large quantities of heat within a limited temperature range, high thermal stability in liquid and vapor phases, resistance to gross thermal degradation at high temperature, ability to vaporize without residue and the ability to absorb heat rapidly from metal surfaces.

A big order. And, at the same time, other fuel properties—viscosity, volatility, and combustion point—must be maintained. Esso hopes it can even improve on them before the project ends. —ARG

SPRAYED-ON CRUCIBLES illustrate the latest in plasma jet techniques—fabrication of shaped parts by spraying atomized refractory materials on shaped mandrels Plasmadyne Corp made these, says "virtually any type of free-standing form" may be fabricated this way. Reusable mandrels make the process relatively inexpensive; furthermore, ability to control jet temperature and atmospheric conditions makes it possible to produce compositions of unusually high purity.

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FROM WASHINGTON . . .

Titanium improves Polaris performance

Polaris engines are now being built with titanium casings. Previously, steel was used for the engine envelope. Reason for the shift in materials was to cut weight and extend range of the missile. Neither Navy nor Aerojet-General, contractor for the Polaris engines, will say just how much weight was eliminated in the metals exchange or what the added range of the missile is. However, one source claims a 33% weight reduction for the titanium. And in a missile's upper stages a 1-lb reduction in weight extends the range from 2 to 4 mi.

All engines going to the first Polaris launching submarine, the George Washington, reportedly will be built with the titanium. No further production of steel-jacketed Polaris missile engines are planned.

Meanwhile, it's revealed that fiberglass casings will be used for the third stage of the Air Force's Minuteman missile. Hercules Powder Co recently won the contract in competition with Aerojet-General. Aerojet's proposal for the engine called for titanium casings. Hercules will build the third-stage engine at its Bacchus, Utah plant. Thiokol Chemical Corp will build the first stage of the Minuteman, Aerojet-General, the second stage.

Compressed air smooths rough waters

The Army Transportation Corps is developing a way to reduce wave action on ships. It will be used when ships discharge cargo in open harbors onto barges or smaller vessels for delivery to shore stations. Primarily, the system is needed to supply arctic and other similarly located areas where big ships can't always unload at docks.

Compressed air will be bubbled into the water in the area around the ships to reduce the size of waves. Laboratory tests have produced good results and a full-scale test is to be made soon at Fort Eustis, Va.

A similar system has been used successfully to prevent ice from forming around piers in the arctic bases. Garden-type hoses with holes punched in them every few inches were placed on the harbor bottom around the piers and compressed air pumped into the hoses. The bubbling action prevented ice from forming around the piers and increased the time during which ships could supply the bases.

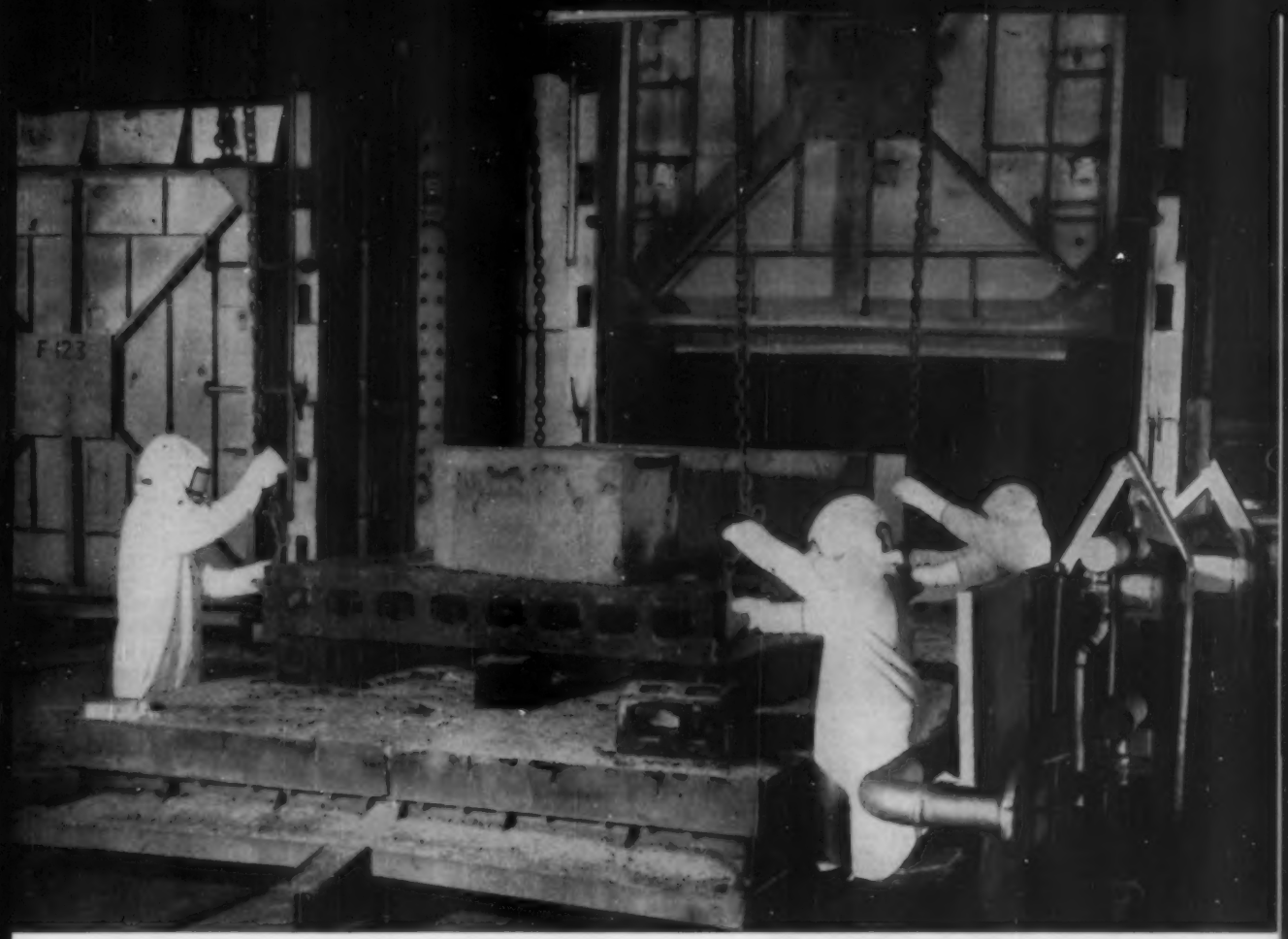
A similar system to reduce ice conditions in the St Lawrence Seaway has been proposed. But additional research is needed before any such system is built.

Scientists urge merchant marine research

The federal government should spend from $100 million to $200 million over the next 10 years in research to develop modern merchant marine ships. That is what some 55 scientists and engineers recommend in a report made by the Maritime Research Advisory Committee established by the National Academy of Sciences–National Research Council. Most of the research should be done outside of government facilities, the committee recommends.

Automation to achieve crew reduction is a key element in the report. The committee wants Maritime Administration to spend some $10 million to $12 million a year, starting now. Some 15% of this money should go for research in hydrodynamics, propellers and foils, atmosphere-ocean interactions, and foil structures, the committee recommends. Other points in its report:

Development of oil-fired gas turbines and advanced steam turbines should take precedence over nuclear propulsion developments. Nuclear propulsion should be continued, but not on a top priority basis. Ships, too, should be built along simple, standardized designs. And efforts should be made to improve the efficiency of shipbuilding methods. These steps are needed, the committee states, if the US it to maintain a strong merchant fleet for peacetime and wartime needs.



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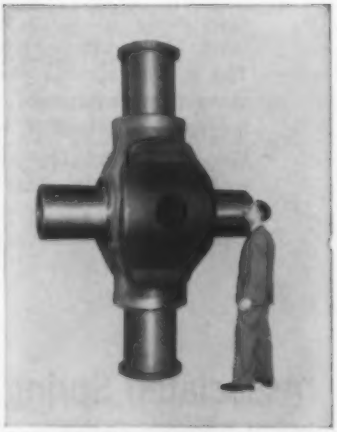

This main axle casting for the 60-cubic yard Mountaineer Shovel was cast in a Blaw-Knox Steel Foundry. Wt.—18,000 lbs.

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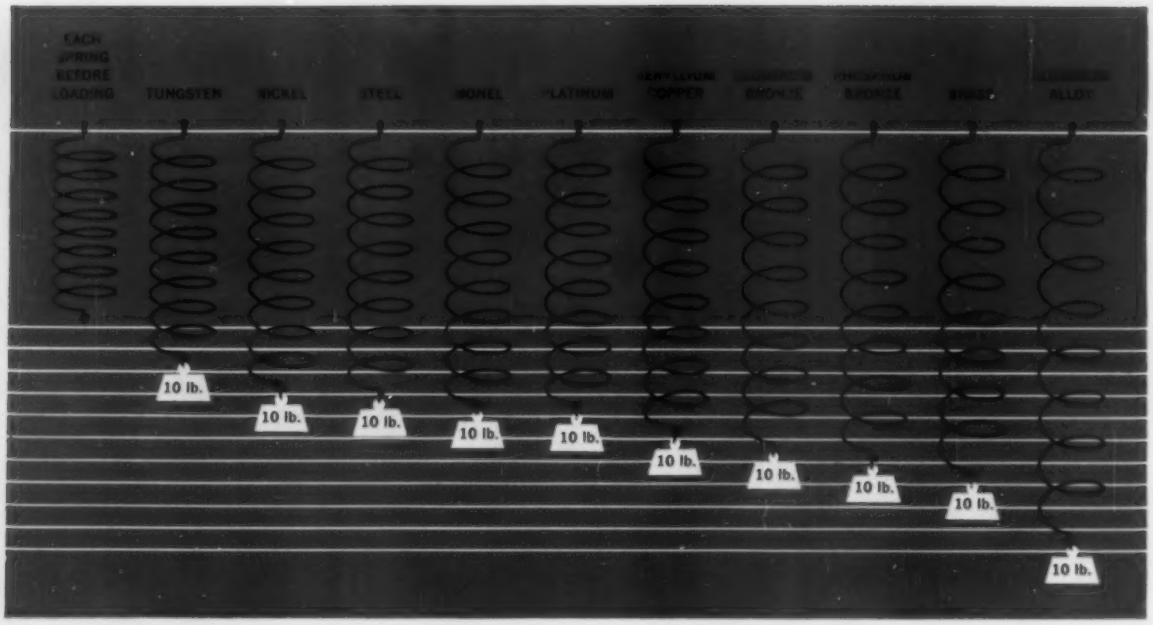

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THE ENGINEERING WEEK

Are Professional Engineering Unions on the Way Out?

One has dissolved; another will poll its members this year. But many units still show vigor. A key question: Should nonprofessionals be allowed in? A leading group is contemplating a merger that would include technicians.

NEW YORK—Last May 10, engineers at Western Electric voted to decertify the Council of Western Electric Professional Employes, the union that had represented them in collective bargaining with the company since 1952. On Sep 8, the National Labor Relations Board will hold a decertification election at Sperry Gyroscope. The election was requested by members of the bargaining unit after the union members voted to affiliate with the International Union of Electrical, Radio and Machine Workers (IUE). These two developments, on top of the demise of Minneapolis-Honeywell's professional union in 1956, lead some observers to speculate that the unions will end up as organizations embracing the interests of two groups –the engineers and the technicians.

Professional unions grew rapidly during the 1940s. In that period some leading companies, with a reputation for excellent engineering, found themselves at the bargaining table with engineers. Included were Lockheed, Sperry Gyroscope, RCA in the Camden area, Western Electric's Kearny plant (the WE unit started in Kearny in 1947, then became bargaining agent for the entire company in 1952), and a GE high-voltage switchgear plant in Philadelphia.

The union movement was given further impetus by creation of a national body, the Engineers and Scientists of America (ESA), in 1950. It now has about 26,000 members. The ESA accepts only professional members. The other national organizations dealing with engineers include professionals and technicians in their membership. Chief among these is the AFTE (American Federation of Technical Engineers, AFL-CIO), which is an old AFL union started in 1918. It now has 18,000 members. The IUE is also actively seeking professional members; and a few others, including the United Auto Workers and the International Brotherhood of Electrical Workers, are picking up a few engineering members.

Opponents of engineers' unions adamantly maintain that unions and a profession are incompatible. Strikes, picketing and other tactics of trade unionism, they say, simply don't blend with a profession. And they find it inconceivable that a man who makes his living through exercising intellectual independence will cede his personal independence to a bargaining agent. The losers, they conclude, are the above-average engineers whose progress is tied to the average, and to the customer who must pay the costs of union-created clerical work at the company when he buys the product.

The opponents also believe that unions are failing to achieve promised professional advantages for engineers. One source at an aircraft company complains that the union at his plant is concentrating primarily on creating disaffection among engineers for the company. The issues it raises are not really beneficial to the engineer, he says, and the situation has become especially bad since the union hired an executive secretary–the paid secretary feels compelled to create issues to justify his job.

A PROFESSIONAL ATMOSPHERE

When combating unions, most companies try to create a professional atmosphere so engineers will not feel the need to join. John R. Glynn, employment relations manager of Sperry Gyroscope, says his company has a realistic appreciation for the contributions of engineers. The company was founded by engineers and has grown through good engineering. In dealing with the union, he says, the company offers raises based on its financial ability. The union has not raised doubts about the company's good faith. The company has volunteered other benefits that have aided the professional development of its members.

Glynn is gratified that the pending election for decertification of the union was initiated by a group of engineers–not by the company. Some engineers, he admits, may be primarily interested in severing ties with the IUE, rather than doing away with a union altogether. When the union announced its intention to affiliate with IUE, the company asked for an injunction to prevent it, based on the clause in the union contract that the Sperry unit would not affiliate with

A Glossary of Major Engineering Unions

ESA—Engineers and Scientists of America (an independent, national union)
- APEP—Assn of Professional Engineering Personnel (at RCA)
- SCEPA—Southern Calif Professional Engineering Association (at Douglas)
- SPEEA—Seattle Professional Engineering Employees Assn (at Boeing)
- WEA—Wichita Engineering Assn (at Boeing)
- WEA-N—Westinghouse Engineering Assn

IUE—International Union of Electrical, Radio and Machine Workers (AFL-CIO)
- Local 418, Arma Corp
- Local 428, Sonotone Corp
- Local 445, Sperry Gyroscope
- Local 482, Ward Leonard Electric
- Local 487, Gulton Industries
- Local 488, Otis Elevator

AFTE—American Federation of Technical Engineers (AFL-CIO). A national union composed primarily of technicians.

ESG—Engineers & Scientists Guild (an independent at Lockheed)

EAA—Engineers and Architects Assn (an independent with locals at Convair and Convair Astronautics)

AEEA—Association of Engineers & Engineering Assistants (an independent at GE)

a production union until it put the question to the entire bargaining unit. The union put the question only to its dues-paying members. The judge who heard Sperry's case ruled that he had no jurisdiction. The company is appealing his decision, and is pressing the appeal in spite of the pending election.

Company managements have shown considerable interest in studies by the Society of Professional Engineers, Deutsch & Shea, and other agencies that have reported on the professional needs of engineers. Many companies admit that engineers have not always been treated as professionals. They were sometimes made to punch time clocks and perform clerical work and otherwise downgrade themselves.

On basis of such studies, companies say they are creating better professional atmospheres. General Electric has worked up suggested standards for engineering departments in its various divisions. Though not binding, the checklist includes suggestions for the amount of space an engineer should have, the technical and clerical help he should have, etc. Engineers at several GE plants have organized professional groups that aid professional development of members through educational progrems. These groups also serve on occasion as a communication link between engineers and management.

Union leaders generally doubt the sincerity of such company moves. They say that engineers and company management are working toward different ends—management seeks profits and engineers seek professional competence. They doubt the engineer can gain fair treatment through working along with management. They also congratulate themselves that the threat of unions has induced many companies to consider their engineering employes more seriously, an attitude that's helped the engineers.

AIRCRAFT UNIONS BUSY

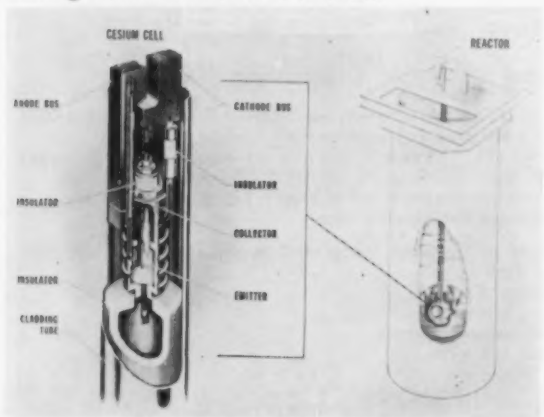
Many of the most active unions are in the aircraft industry. One vigorous group is the Engineers and Scientists Guild (an independent union) at Lockheed's California Div. ESG leaders claim engineers in its bargaining unit are the highest paid group in the US in their engineering classifications. The bargaining unit consists of 2570 engineers, of whom 1225 pay dues. (A bargaining unit is certified by the NLRB, and all members benefit from union contracts whether they pay dues or not.)

One of ESG's major achievements, the union sources say, was negotiating an equitable layoff procedure for engineers—a mechanism that was required by the swings in aircraft industry employment. Under the plan, each engineer receives a "retention rating" twice a year. The rating is based on the individual's technical competence, performance and seniority. The ratings are so specific, the union says, that few grievances result.

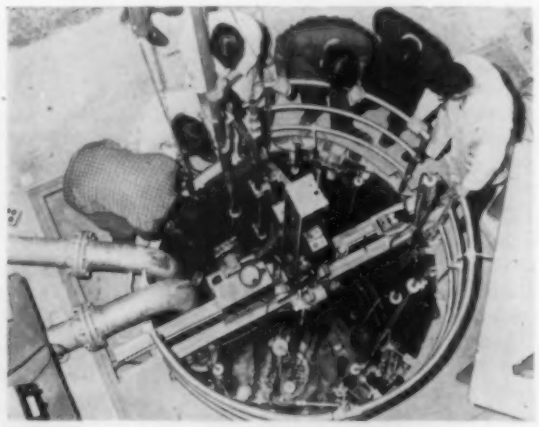
This year, ESG says, its demands are modest because of defense cutbacks. Chief aim is to obtain increased recognition for outstanding engineers by boosting top salary men into the next salary bracket—a move that is expected to counteract the compression of salaries that has occurred as starting pay for new graduates is constantly raised. The problem of salary compression has been an important consideration in union negotiations at other companies. The ESG is also trying to correct certain general company personnel policies that it feels inhibit professional development when applied to engineers. The union says that Lockheed engineers, for example, can afford foreign travel but cannot go abroad because they have only two weeks' vacation.

At Douglas Aircraft, the Southern California Professional Engineering Association, a unit of the ESAs, is now in the throes of court-ordered arbitration with Douglas. The aircraft company announced a 10% pay decrease for salaried personnel last April. This decision was later modified to include only employes earning over $12,000, a modification which still affected 450 Douglas engineers. In union's view this was a violation of the Douglas-SCPEA contract. After it was unable to get Douglas to re-

Boiling Electrons Give 90 Watts



A cesium-cell thermionic converter has produced 90 w of electric power directly from heat of nuclear fission at the General Atomic Div of General Dynamics Corp. Drawing shows major components. The nuclear fuel element in the cell was made of uranium carbide and zirconium carbide. Electrons, "boiled out" of the emitter by heat from uranium fission, were collected by a current collector surrounding the emitter. Cesium vapor was used in the gap between emitter and collector to enhance the rate of power production. Photo shows converter being lowered into the reactor. Cell is located near bottom of the 12-ft-long aluminum tube, which also contains the electrical leads.



instate pay cuts, the union took the matter to court. The court upheld the union, ordering compulsory arbitration. Hearings were held July 22 and some form of decision is expected momentarily.

Douglas' union says its chief accomplishment has been to give engineers insight into personnel regulations that affect them, and to spell out personnel benefits that its members are entitled to. The union is presently aiming to modify these rights. Among its goals is a layoff procedure patterned on Lockheed's and a vacation bank by which Douglas engineers can accrue vacation time if they do not choose to use it in a calendar year.

A third large aircraft union is the Seattle Professional Engineering Employees Association, also a unit of ESA, at the Boeing Airplane Co. SPEEA represents a bargaining unit of 8650 engineers. The union feels its greatest accomplishment in behalf of members was to eliminate cents-per-hour blanket increases in favor of constant percentage increases. Considerable union effort has concentrated on eliminating salary compression. To this end, the union a few years ago got a 1% payroll raise distributed to the top 25% of the payroll. They have also won a company-paid retirement plan, obtained overtime pay for engineers and eliminated such unprofessional symbols as time clocks.

STRIKE AT RCA

The major strike of the year was called by the Association of Professional Engineering Personnel (APEP), an ESA unit, at RCA. At issue was a company move to change the merit review plan. The merit plan, similar to those in aircraft industry, determines who shall be retained in a layoff. Engineers accumulate retention points through education and years of engineering experience (at RCA or elsewhere); through their engineering value as determined by salary; and through annual job-performance evaluation. RCA, according to the union, wished to do away with the value points and simply use the last merit review to determine who should be laid off. APEP objected on basis that company was seeking an arbitrary change in an established practice, and the union did not feel that basing a man's retention on the last merit review was really fair. With the strike settlement RCA agreed not to change the retention credit plan without giving the union six months' notice. The RCA union has 2450 engineers in its bargaining unit, of which 1975 are members.

In the view of many companies, the least evil is an independent union. The independents, they find, are more responsive to the wishes of the engineers they represent. And they are somewhat more reasonable in demands and grievances.

The locals and small unions without a full-time paid secretary generally have a more difficult time gaining company recognition than the big national unions. The problem, as Ralph Molloy, chairman of the Engineers and Architects Association (an independent union) at Convair puts it, is that "It's tough to get engineers, who work all day, to take an interest in what the union is doing." Managements sometimes complain at the rapid turnover of union officers, which means that the man at the bargaining table is always inexperienced.

TECHNICAL VS PROFESSIONAL UNIONS

One of the problems now besetting ESA—and very important to the future development of engineering unions—is a decision on whether the national organizations should accept only professionals, or technicians as well. ESA lost 18% of its membership in 1957 when a schism developed within the union over this issue. Those favoring limited membership won out; whereupon Sperry, Lockheed, Pacific Gas and Electric, the Tennessee Valley Authority and those employed by the city and county of Los Angeles left the union.

The struggle for professional purity was at the heart of ESA's loss of its Western Electric unit this year. NLRB certified the Council of Western Electric Professional Employes, affiliated with ESA, to represent the company's engineers in collective bargaining with the company at an election in 1952. The company was free to promote any men it considered qualified into engineering positions within the CWEPE bargaining unit. In 1955, according to company sources, the union complained that its bargaining unit had been diluted with men who were not really professionals. The union took the case to NLRB in 1957.

In discussions with the NLRB, the union held that education or experience should determine whether or not a man is a professional. The company held that work he performs is the proper criterion. The board ruled in favor of the company, saying that the Taft-Hartley law, which defines a professional, bases its definition on "work" being performed. The NLRB then reviewed the cases of a number of disputed employes to determine if they should remain in the bargaining unit on basis of the Taft-Hartley definition. Finally, the board ordered an election among qualified members of the bargaining unit on May 10 to determine if they still wanted CW EPE to represent them. The engineers turned the union down by a vote of 3970 to 2603, with 98% of eligible engineers voting.

ESA is still lending encouragement to its supporters in WE and says it plans to ask for a new representation election next year. It thinks it has a 50-50 chance of winning. The union attributes its improved chance to layoffs at a North Carolina plant brought about by cutbacks on the Nike-Zeus antimissile missile. The union feels that its main opposition came from the company's plant in North Carolina, most of whose employes were southerners and tended to be anti-union. Now, ESA predicts, these engineers may have second thoughts about getting on without a union.

PROBLEMS OF ALLIANCE

In the light of recent reverses, ESA is contemplating an alliance with AFTE. As an independent, ESA finds going rough outside the mainstream of the American labor movement without the financial resources of AFL-CIO behind it. The AFTE, on the other hand, has not been successful in halting raids by other AFL-CIO unions. If the merger goes through, ESA must give up the principle of professional membership and accept technicians as well.

Joseph Amann, president of ESA, says he personally favors the move, and has begun a program of education and reorientation among members to build merger sentiment. Final action, he feels, is a year or more away. ■

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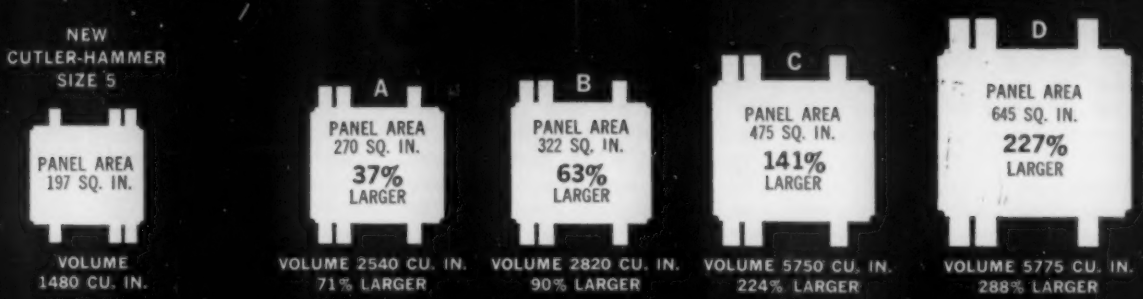

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CAB Digs Deeper into Electra Troubles

Los Angeles—The CAB's latest hearing on Lockheed's troubles with its Electra propjet plane has added some engineering details to the meager amount previously released.

Although this 3-day hearing was more a legal formality than a searching investigation, CAB investigators seem convinced that two Electra crashes (Northwest Airlines, at Tell City, Ind., and Braniff Airlines, at Buffalo, Tex) occurred in much the same way (*PE—May 2, p 15*). Both resulted from wing failure which, the CAB believes, occurred when a sudden, marked disturbance in the aircraft's attitude started a series of vibrations that tore off the wing within 40 seconds.

But observers remain not entirely clear as to cause of the disturbance. It could have been from an autopilot command, air turbulence, or even an engine power surge. In any event, the CAB investigators say, it was enough to slightly deflect the left outboard engine nacelle.

The engine rotor was turning at better than 13,000 rpm; the prop was rotating at 1280 rpm. These were enough to convert the deflection into a circular, oscillatory movement of the nacelle in a direction opposite to that of propeller rotation. The engine nacelle's oscillation then caused severe torsion and bending movements in the wing. All three vibrations immediately reinforced each other, quickly breaking the wing structure.

Lockheed insists that a resonant coupling of nacelle and wing vibrations can't occur on Electras under normal structural conditions, even in turbulent air. The company claims its intensive testing shows that the three types of destructive vibrations can't develop unless the aircraft's nacelle structure has been previously weakened. One cause: hard landings.

At an earlier CAB hearing, an Electra passenger who disembarked at Chicago prior to the Northwest accident, said the aircraft had been set down hard on landing. The problem: What constitutes a hard landing? And are its effects accumulative?

Electra modifications are scheduled to begin in November in Lockheed's Burbank plant. Retrofit will take about 20 days per plane with Lockheed absorbing all costs except transportation of the aircraft to and from the Burbank plant. Exact nature of the modifications, other than strengthening of nacelle, wing structure and attachments, has not been released.

Lockheed's chairman, Robert E. Gross, did tell the New York Society of Security Analysts recently that agreements have been reached with the operators of 110 of 138 Electras in service. In consideration for Lockheed paying substantially all costs of modification, the airlines waive any claim for consequential damages arising out of the accidents and the restricted Electra operations. Gross gave Lockheed expenses:

Expected Electra modification costs	$11,441,000
Electra investigation costs	1,241,000
Total (net after taxes)	12,682,000

Outside sources have contended that the original $25 million before taxes estimated by the company for Electra modification and investigation was conservative. Based on the above, Lockheed estimates appear correct. ■

Fleet of Fuel-carrying Tires Joins Army

These tires, each carrying 500 gal. of gasoline, are being towed by a US Army personnel carrier. Developed by Goodyear Tire and Rubber Co to specifications of the Army's Transportation Research Command, the rolling liquid-transportets can be towed by virtually any vehicle—on land or water—because their unusual construction gives them low-ground-bearing pressure on a wide contact area. This allows them to function in the most difficult off-the-road conditions. Here being towed across a German lake, the tires bobbed two ft out of the water even with a second set added in tandem.

Hungarian Claims Versatile Lightmeter

Budapest, Hungary—A luminosity instrument that can also determine directional sensitivity of microphones and loudspeakers, and measure heat intensity of infrared lamps, is claimed by a Budapest research engineer. As described in the Hungarian technical press, this is another of those so-simple devices that probably has been invented elsewhere; but it could be a helpful research tool.

It consists of a centrally located photoelectric cell, around which the light being tested rotates orbitally, a photographic-plate holder which rotates with the light, and a galvanometer which records luminosity distribution on photographic paper.

The unit is completely automatic, Sander Katona, the inventor claims, so a continuous record of light distribution is produced.

For infrared lamp measurements, a thermoelectric pickup replaces the photocell, and a sound transducer is used for microphones. ■

Air Bearings Reduce Cost of Table Control

LONDON—Pressurized-air bearings show great promise on automatic machine tools, says the National Engineering Laboratory, East Kilbridge, Glasgow, Scotland. By reducing stiction, air bearings allow smaller servomotors and associated control gear. These serve to reduce over-all cost of automatic controls.

Advantages claimed for these bearings in machine-tool applications:

- Extremely low friction, both static and dynamic.
- No metal-to-metal contact, hence no wear.
- No temperature rise during use, permitting sustained high-speed operation with high rotational precision.
- No oil circulation requirements.

Tests on a horizontal milling machine bear out these claims. Power required to drive the worktable was reduced a hundredfold when the table was mounted on air bearings. For example, climb-milling cuts of ¼-in. depth were made in 2-in. mild-steel bars at feed rates up to 6 in./min. using a 1/50-hp motor to drive the table. Table weight of 500 lb required an additional 600 lb dead-load to reduce clearance of 0.001 in. to zero.

Air bearings were two brass strips drilled with 0.02-in.-dia holes at 1½-in. intervals. Holes were connected internally, and with an air supply of about 5 cfm at 600 psi, the table floated 0.001 in. clear of the bed. ■

30,000 World War II R & D Reports to Be Declassified

WASHINGTON—The Defense Dept has declassified some 30,000 technical reports on R & D performed during World War II by the Office of Scientific Research and Development.

The reports will be available to the public within 3 months. Right now, the Dept of Commerce's Office of Technical Services is preparing a 700-page index of the studies. Actual purchases of the documents will be handled through the Library of Congress where they will be available mainly in microfilm form.

Included in the material are hundreds of reports on metallurgy, materials and propulsion. A 68-volume summary of the 30,000 reports may be published. Right now, a survey is being made of industry, universities, etc., to see if there is sufficient demand for the summaries to justify printing them. ■

Soviets Spur Design of Hydrofoil Riverboats

Moscow—At the behest of Premier Khrushchev, Soviet designers are reportedly moving ahead on development of hydrofoil vessels for carrying river freight. A design bureau at Gorky's Sormovo shipyards on the Volga has already produced two generations of passenger-carrying river boats—one the 66-seat Rocket, the other the 150-seat Meteor.

According to press reports, Khrushchev told designers to build freight vessels, after viewing a demonstration of the Meteor. This vessel, it is said, subsequently served as model for a hydrofoil vessel to carry 20 tons of freight as well as 30 passengers.

An even more advanced freighter is reportedly in blueprint stage. It will be equipped with refrigeration to preserve fruits and vegetables en route to central Russia and will carry 300 passengers at speeds of around 60 mph.

Designers are studying both diesel and gas turbine powerplants. The body of the freighter will be of welded aluminum alloys. The Meteor's body was constructed of riveted duraluminum. ■

German Firms Form Joint Research Unit

BONN—Daimler-Benz and Maybach Motorenbau have jointly contributed $25,000 capital for a new company to carry out research on high-speed industrial engines. The new firm will be called Industrie Motorenbau GmbH and have headquarters in Stuttgart.

The parent companies have worked independently in the field; will now coordinate efforts through the new subsidiary. Extensive research will be on marine and locomotive engines, but the parent companies are also believed to be interested in large gas turbine prime-movers. Eventually the new company is expected to open production facilities in a plant now operated in Maybach. ■

"Pot" Makers Form New Organization

FULLERTON, CALIF—Twenty-five leading manufacturers of precision potentiometers are forming their own professional organization to establish potentiometer standards. As yet unnamed, the organization is drafting a constitution and bylaws for presentation and approval this October. The group's goals are:

- Maintaining standards of excellence leading to maximum performance and reliability.
- Encouraging the standardization of ratings, nomenclature, and test procedures and equipment.

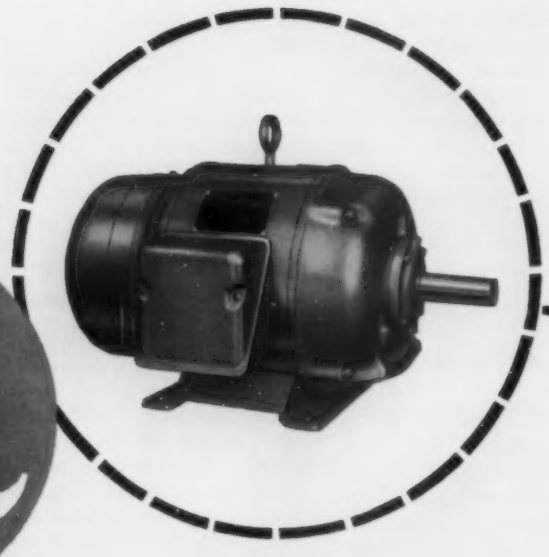
Chairman of the constitution and bylaws committee is David C. McNeely, manager of Beckman's Helipot Div. ■

Italians Vote Funds to Nuclear Research

MILAN—The Italian government is stepping up its nuclear research. The Senate and Parliament have approved the Colombo bill, which sets up a new agency, the National Committee for Nuclear Energy (CNEN), and appropriated $120 million to it for nuclear studies during the 4-year period from 1960 to 1964.

CNEN has been instructed to promote and coordinate studies in chemistry, physics, mathematics, biology, medicine and nuclear engineering. It will give scientific and technical supervision to groups using nuclear materials or producing nuclear energy; will also encourage training of additional nuclear specialists and maintain collaboration with international organizations.

Though nuclear sciences are more amply supported than other scientific fields here, many Italians felt their nation should be putting more money into nuclear activities. The new law is said to be responsible for providing both an intensified and stabilized nuclear program. ■



Motors Thrive on FREQUENT OVERLOAD ABUSE!

***Brunswick* D-31 Precision Bowling Lane Sanders**

Powered by Lightweight R&M 8 HP Single Phase Motors

The Brunswick-Balke-Collender Company recently handed ROBBINS & MYERS an unusual motor problem when it re-powered the Brunswick D-31 precision bowling lane sander. The D-31 cuts across 250 square inches of area in one continuous cutting operation. Motor must withstand frequent and severe overloads when the machine levels high spots in the alley bed. Power had to be single-phase, too, because many bowling establishments carry only single phase current! To keep sander truly portable and easily maneuverable . . . and to protect lanes from excess weight, motor had to be lighter than ordinary single-phase motors.

ROBBINS & MYERS custom-designed an 8 HP capacitor-start, capacitor-run motor that is daily proving its stamina against these rugged requirements. Should more power be needed, design includes provision for adding an auxiliary blower which can conveniently increase capacity to 10 HP. Weight was kept down by using special aluminum end heads. For easier maintenance, the extended end-head housing can be removed quickly and easily to expose condensers and centrifugal switch.

Many other features insure longer life for *every* R&M motor: double width bearings that have extra-large grease capacity . . . Mylar* insulation with 8 times the dielectric strength and 35 times more moisture resistance than ordinary paper insulation . . . removable caps for quick bearing inspection and relubrication . . . end heads that give full-height protection . . . dual-sweep ventilation for efficient cooling.

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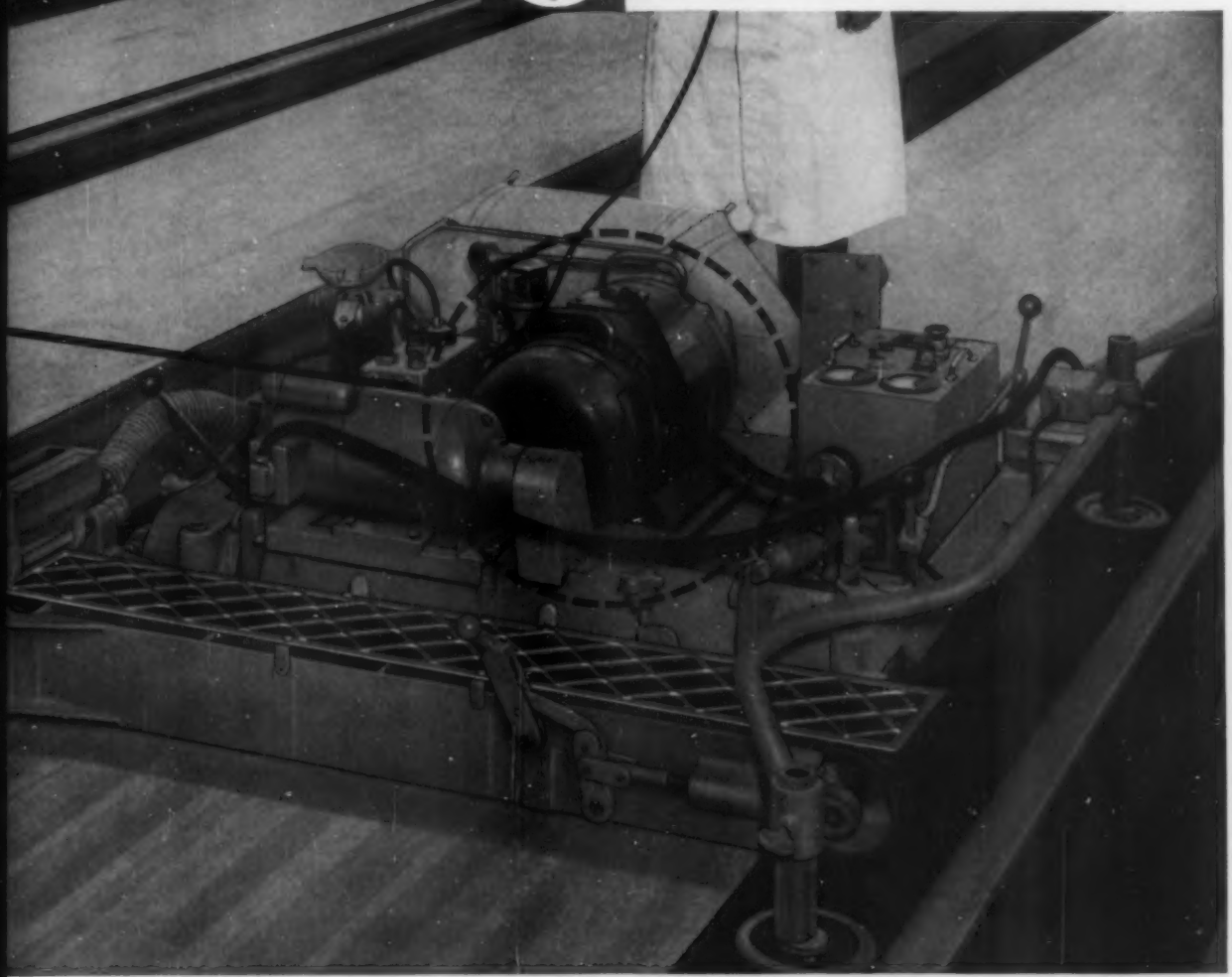
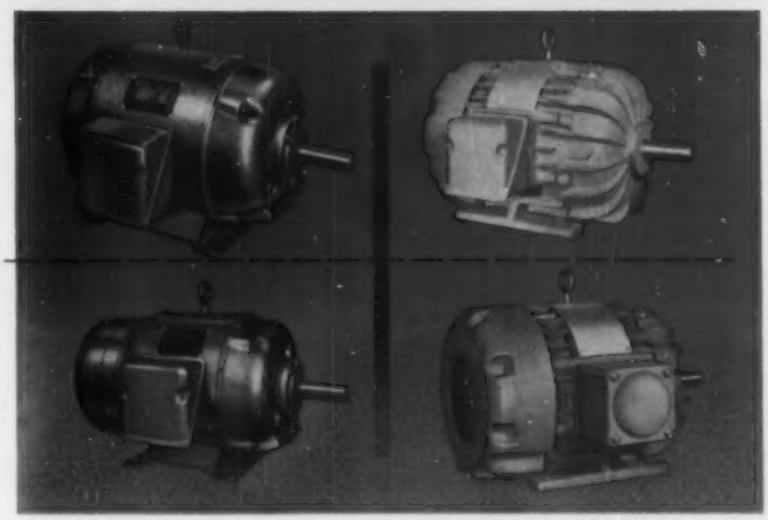
(other ratings 1/200 to 1 horsepower)





Open Protected Motors (left), up to 200 HP, are suitable for many applications formerly requiring totally enclosed construction.

Totally Enclosed Motors (right), ½ to 200 HP, are fan-cooled . . . offer complete protection against all harmful atmospheres.

"PM" Single Phase Motors (left), ratings through 20 HP, eliminate maintenance because they are fully weatherized for severe duty.

Explosion-Proof Motors (right), ratings through 200 HP, are Underwriters' Approved for Class I, Group D, and Class II, Groups F & G.

CIRCLE 23 ON READER SERVICE CARD

POINTS OF VIEW

THE QUESTION: *What Technical*

Col Preston L Hill
Chief, Manufacturing and Materials Technology Div
AMC Aeronautical Systems Center

"The new extremely hard metals . . .
being planned for future aerospace and weapon systems pose a considerable challenge to the continued effective use of conventional machine tools and edge-cutting tool systems. Perhaps the weakest link in the chain of conventional machining mechanisms under these unusually stringent cutting conditions is the cutting tool itself.

"Even with the advent and refinement of numerical controls to impart an exceedingly high degree of accuracy in the control of machine-slide motions, the tolerance of the final product still depends largely on the ability of the cutting tool to retain its size by resistance to premature wear and, most important, to withstand breakage as a result of high cutting forces and impact loads.

"Several problems remain concerning the technological aspects of machine-tool design and development. The importance of high-quality, low-quantity production requirements of the military would suggest inherent machine versatility combined with numerical controls to satisfy the sequencing of such machining operations as drilling, boring, tapping, milling, slotting, for application to a large variety of part configurations.

"High torque requirements at relatively low speeds, coupled with exceptionally high dynamic loadings when converting these extremely 'hard to cut' materials into usable shapes, will considerably aggravate vibration and deflection characteristics within a machine tool. These characteristics must be brought to a scientific level of understanding so that machine-tool designs can be made to reflect rigidity requirements commensurate with military job needs.

"From a viewpoint of military products, if the conditions briefly described herein go entirely unattended, then conventional machining may have to relinquish first position in the materials-removal field."

"Problems in the technology of machine tools . . .
fall into three main areas: First, extreme precision and versatility for handling difficult materials and odd shapes in limited quantity; second, reliable volume production combined with some versatility to meet product changes; and third, economy of first cost and maintenance for simple, standard operations.

"Although many of the same problems arise in all three areas, the solutions are likely to differ radically. Here are some of the specific problems for which better solutions are needed:

- Basic research in vibration and deflection of machine frames could lead to less dependence on dead weight to prevent chatter.
- Better solutions to the problems of backlash and what is sometimes called 'stiction' will be required, particularly on machines with numerical control systems.
- Simpler control systems are desirable. Simpler programing is even more desirable, even at the cost of complexity in system.
- Development of a uniform approach to standards of accuracy is essential. Such standards will permit builders and users to evaluate capability with consistency.
- Detailed application of an approach such as value analysis to the design of the standard general-purpose machines will avoid overdesign.
- Debugging time on special machines, which may run three months or more, should be reduced. It can probably never be eliminated completely, but methods are needed for designing and building the machine so that less debugging time is required."

Anderson Ashburn
Managing editor
American Machinist/ Metalworking Manufacturing

Improvements Do Today's Machine Tools Need?

Myron S Curtis
Vice-president, Engineering
The Warner & Swasey Co

"Perfection of numerical control . . .
is the biggest technological problem facing the machine-tool industry today. Big strides have already been made in improving the reliability of numerical-control components, but we still have a long way to go in reliability and in the allied problem of reducing and simplifying maintenance. Numerical control is going to have to become cheaper as well; this, I think, will come both through simplification in design and less expensive components in the years ahead.

"If there is any doubt in anyone's mind that numerical control will continue increasing in importance, that doubt should be dispelled by a visit to the exposition in Chicago. Machine-tool companies don't invest the kind of engineering time and money represented by the NC installations at the exposition without a real conviction that there is not only a perfectly sound economic justification for the present but an even greater potential for the future.

"A technological problem of perhaps less current industrywide importance is in finding more ways to make finished pieces without making chips. Some of the new exotic materials have brought us machining problems that cannot be solved by conventional machining methods, and although a promising beginning has been made along several lines, a great deal of work remains to be done. The real potential in chipless machining is that some of the eventual solutions to shaping exotic materials may prove economically feasible with common materials as well."

"One major problem . . .
in our industry is a paradox: During the past 20 years, with the advent of new cutting tools and higher powered equipment, we have increased metal-removal rates to the point where the percentage of the working life a machine actually spends making chips is very small—typically 10 or 15%. So we must now look elsewhere for improvement in productivity. Hence numerical control, with its tremendous potential for economical short-run production, reduced inventory, short lead time, and a rethinking of the entire small-lot production philosophy.

"Improvements in metal cutting, which fostered this paradox, now become a problem. The programer who commits the operation to tape for the first time finds himself none too sure of 'what to put.' His confidence in specifying cutting conditions on a new part, which will represent anything like an optimum and give him a good piece the first time, is none too high. He has lost the opportunity to cut and try.

"Another problem, in machine-tool management, arises from the increased technical sophistication of products in the past 10 years, particularly in controls. Product evolution today is far more rapid than ever before, and this can bewilder a nontechnical management. Reinforcement of machine-tool management with technically trained and experienced members is imperative.

"A third problem is, in a sense, not a technical one. It derives from the increasing use of complicated automatic controls of all sorts, which may represent one-half of the total cost to the machine buyer. When the machine builder gets his equipment from a control manufacturer, the ultimate customer is far removed from the component manufacturer, and the price becomes almost prohibitive. This tempts the machine-tool builder to design and build his own controls (this also improves his much-out-of-balance make-to-buy ratio), or to merge with, or acquire, a control manufacturer. It also raises the interesting question: Are the control manufacturers going to dominate the machine-tool field; or are the machine-tool builders going into the control field?"

David N Smith
Chief development engineer
Jones & Lamson Machine Co

GASKET SEALS vs. FLANGE FINISH

Smooth flanges usually help simplify gasket problems . . . but they raise machining costs. Can a gasket material compensate for flange roughness so well that machining costs can be reduced?

E. M. SMOLEY
Research Physicist
Armstrong Research and Development Center

How smooth do flange surfaces in gasketed assembiies have to be? Is there a gasket that will seal so efficiently that reductions in flange surface smoothness might be practical?

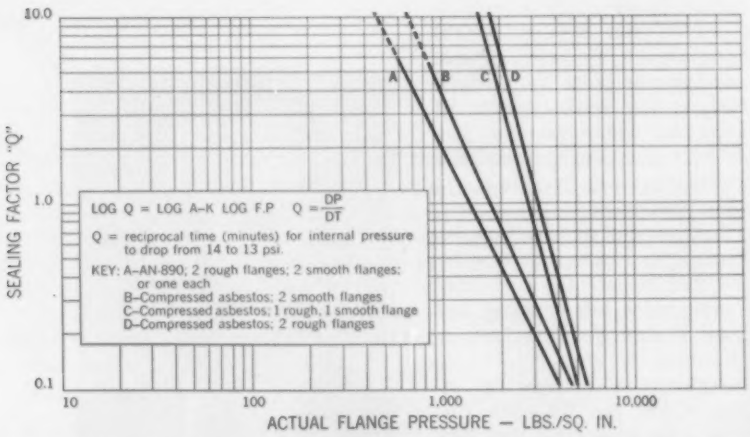
To answer these questions, extensive tests were conducted at the Armstrong Research and Development Center, using rough (3000 micro-inch) and smooth (5 micro-inch) flange finishes.

Two different gasket materials were compared: one, a standard grade of compressed asbestos; the other, Armstrong Accopac AN-890, a beater-saturated rubber-asbestos material. Both were 1/32″ gauge.

In each test, air was locked in gasketed flange assemblies at an internal pressure of 14 psi. Then pressure loss was measured and recorded as a function of time by the electro-mechanical air leakage tester developed by Armstrong engineers.

Many individual tests were run, using two smooth flanges, two rough flanges, or one of each. The results are condensed on the chart below.

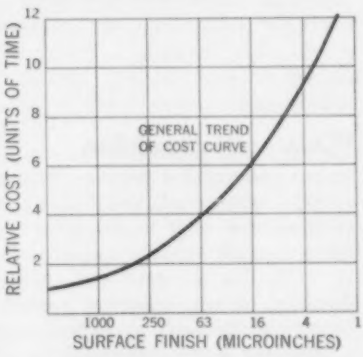
The curves show that AN-890 has far better sealability with either rough or smooth flanges — or one of each — than the compressed asbestos material. Even at the relatively low flange pressure of 1000 psi, the unusual sealing ability of AN-890 is evident.



Condensed results of sealing tests on smooth (5 micro-inch) and rough (3000 micro-inch) surfaces. Sealing efficiency plotted along vertical axis, with lowest point representing best seal. Example: At 1000 psi flange pressure, Accopac AN-890 (A) has a sealing factor of about 1.8; Curve B, a factor of about 3.6; other curves are off the chart. All testing done at room temperature.

The superior performance of AN-890 is a result of the way it's made. The patented beater-saturation process gives a more uniform dispersion of rubber on fiber — hence, AN-890 is a more compressible material. As a result, it has unusual conformability to flange irregularities.

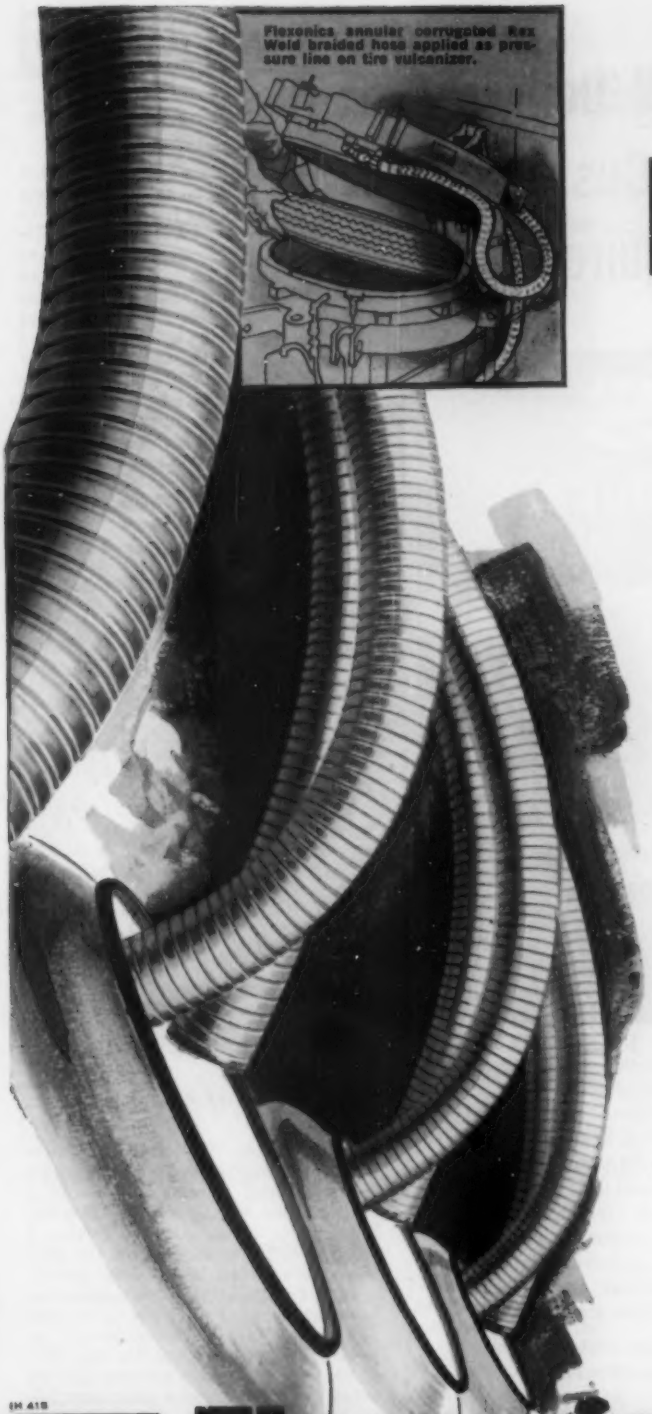
These tests indicate that Accopac AN-890 offers definite promise of efficient seals at higher micro-inch flange finishes. This can represent a potential saving in machining costs that is well worth considering. We would be glad to discuss specific applications with you.



As micro-inch finish is reduced, machining costs climb more and more steeply. (Chart: Machine Design.)

If you do not already have a copy of the Armstrong Gasket Design Manual, send for it today. It contains much data on the selection and design of resilient gasket materials. Address your request to Armstrong Cork Co., 7108 Irvin Street, Lancaster, Penna.

Armstrong GASKET MATERIALS
1860-1960 Beginning our second century of progress



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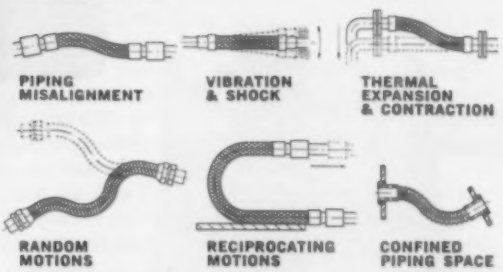
Controlling effects of pressure and temperature in conveying solids, liquids or gases is the job of metal hose. Motion (illustrated below) is another factor common to all piping problems in one form or another. Flexonics sales engineers are "pipe motion specialists" . . . capable of anticipating and providing for any need in this direction.



(Left) A battery of Flexonics RT-6 galvanized steel hose assemblies installed in the tablet coating room of an internationally recognized pharmaceutical corporation. One hose is a hot air carrier (110°F), to hasten drying of tablet coatings. The other hose draws off excess air from the large pans, preventing powder dust.

IH 415

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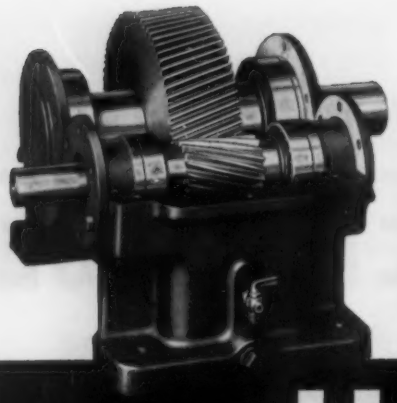

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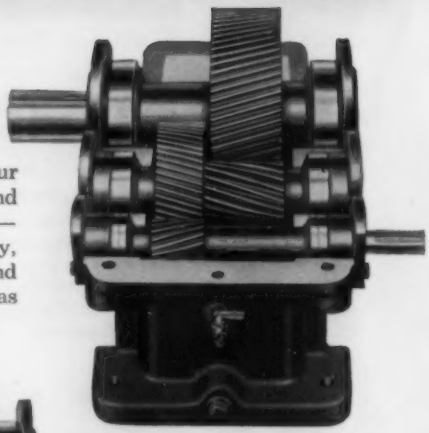

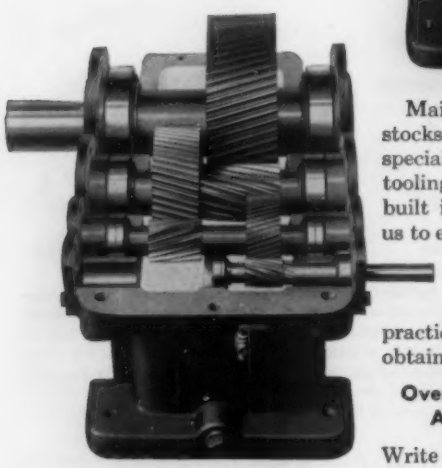

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READER TO EDITOR

Oh, For The Fishy Life

To the Editor:

I see where one of your readers (Richard Paulson, in the July 18 issue p 28) decries the lack of financial support for R. Buckminster Fuller. He wonders what "tremendous benefits to mankind" would result if Juan Peron or some other wealthy bounder were to invest his money in helping Fuller instead of "creating unrest in the world."

It seems to me that Mr Paulson, like many others today, regards all technological "advancement" as a tremendous benefit to mankind. We strive mightily to control our world, eschewing crackthroughs in favor of breakthroughs and, more recently smashthroughs. Yet all the while, schools of dolphins languish happily off the coast content "merely" with being part of their world. It comes as no surprise to me that scientists recently discovered that these good-natured sea creatures display more intelligence and seem to learn more quickly than mankind.

—S C Wallace
Hamilton, Ont

• Does Mr Wallace support an MIT for dolphins?—Ed.

Design File Book

To the Editor:

You are to be complimented for your feature, "Design File." Several of our engineers would like to have personal files of these. Do you anticipate compiling these into book form?

—Benton A Vizzier
Manager of engineering
Fryling Electric Products Inc

• Such a book is now available. Written by associate editor Douglas Greenwood, it was published by McGraw-Hill Pub Co last September. Price $9.—Ed

Government Pay Boost

To the Editor:

Your news story "Government Engineers Reap Pay Raises" (July 18, p 12) violates the engineering principle of objectivity relative to the recent pay boost. You say, "It puts the starting salary up to around $6345 (GS-7) for the bulk of the engineers and scientists hired by the government." For the record, new engineering graduates are hired in at the GS-5 grade now paying $5335. This grinds out at $435 per month. Being in the top 10% of his class will qualify him for GS-7 at $6345; however, I doubt if government can compete for these individuals against private industry.

Secondly, you say, "Most of the thousands of such personnel employed by the government are lumped in the GS-12 and GS-13 brackets, now paying $10,255 to $11,935." The starting salary of a GS-12 is $8955. As long as he remains a GS-12, his salary will increase $260 every 1½ years, up to a maximum of $10,255. A GS-13 starts at $10,635 and increases by the same

increments to $11,935. Ratio-wise I can only assume ours is a typical picture, i.e. out of an engineering activity consisting of 50 individuals (47 excluding clerical), we have one GS-13 and two GS-12's.

—C E Morris
Macon, Ga

Old Gears

To the Editor:

Being a subscriber and an admirer of your publication, I read with astonishment your article "Coarse-fine Gearing Devised in West Germany" (July 8 '60, p. 8).

The device shown was invented over 30 years ago by a Frenchman, M. Thomas of Thomas-Wireless (Paris). It has been on sale since about 1930 and I personally bought one around 1932.

—Frank Samet
NYC

Corrected Equations

To the Editor:

Your readers should know about three errors in my article "New Equations for 5 Tapered Cantilever Beams," July 25 issue:

On p 54, diagram for "Concentrated Load at End," equation should be

$$y_o = \frac{2F}{3EIC_o}\left(\frac{L}{R_L}+R_o\right)^3\left\{1+\frac{3}{4}\left(1+\frac{R_o}{R_L}\right)^2\right\}$$

On p 55 diagram for "Uniform load," equation should be

$$\gamma = \frac{WL^3}{3EIC_oR_L^3}\left[\frac{3}{4\left(1+\frac{R_o}{R_L}\right)}+\frac{1}{\left(1+\frac{R_o}{R_L}\right)^3}\right]$$

$$y_o = \frac{WL^3}{4EIC_oR_L^3}\left[\frac{2+\left(\frac{R_o}{R_L}\right)+\left(\frac{R_o}{R_L}\right)^2}{\left(1+\frac{R_o}{R_L}\right)^3}\right]$$

—W R Petri
Consulting engineer
Toronto, Canada

COMING EVENTS

SEPTEMBER

6-16 . . . . National Machine Tool Builders Association, Production Engineering Show, International Amphitheater, Chicago

7-9 . . . . American Society of Mechanical Engineers jointly with AIChE, AIEE, IRE, and ISA; Joint Automatic Control Conference, Massachusetts Institute of Technology, Cambridge, Mass

26-28 . . . . Standards Engineers Society, 9th Annual Meeting, Hilton Hotel, Pittsburgh

26-30 . . . . Instrument Society of America, Instrument-Automation Conference and Exhibit, New York Coliseum, New York.

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- *Prevent Wedging of Pump or Valve Bodies* with tapered threads.
- *Allow repeated disconnection and reconnection without leaks* — No threads to wear — no tapered seats to groove.
- *Reduce Production Costs*—costly threading operations eliminated.
- *Simplify Connections* — no separate swivel or union connections required.
- *Permit Faster, Easier Connections* — to disconnect, only one bolt need be removed.
- Are Available with Pressed-On or Reusable Couplings and with Weld-type Fittings.

Flanco assemblies are your best bet for connection of hose assemblies to valve or pump parts — for hose to manifold — for pipe to pipe, pipe to hose and hose to hose in high, medium and low pressure systems.

Write for Catalog No. 402 for complete description and specifications

Andy Anchor says:
"Visit our Booth 156 Sept. 12-15 SAE's Farm, Construction and Industrial Machinery Engineering Show, Milwaukee, Wis."

ANCHOR COUPLING CO. INC.
333 North Fourth St., Libertyville, Ill.
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CIRCLE 29 ON READER SERVICE CARD

BEARING BRIEFINGS

One in a series of technical reports by Bower

ROLLER GUIDANCE– VITAL FACTOR IN BEARING LIFE

Roller guidance has been established by the Anti-Friction Bearing Manufacturers Association as a major rating factor for roller bearings. There is a direct relationship between this factor and the life and capacity of a cylindrical roller bearing under load.

Figure 1 illustrates the results of a loose fit between a roller and the guiding ribs of the raceway. Because of lack of guidance by the ribs, the roller is free to skew and skid under load. Such a condition invariably leads to early bearing failure.

To achieve close roller fit and proper roller guidance, Bower precision grinds each bearing race on specially designed centerless grinders. In this operation, Bower positions the integral raceway ribs *from the theoretical centerline of the bearing*. This method produces bearings with high dimensional accuracy and perfect symmetry.

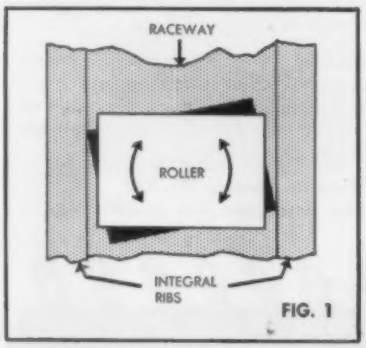
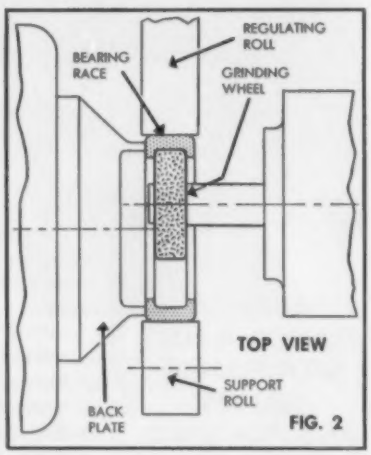
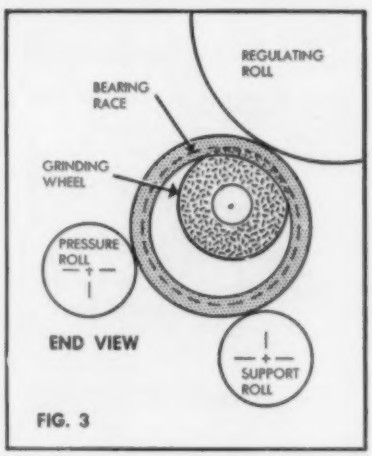


Fig. 1. Loose fit in raceway means poor roller guidance. Roller can skew and skid under load.

In addition, the close tolerances held in grinding the roller track and integral guiding ribs give Bower cylindrical roller bearings the ability to *take thrust in any direction*. A Bower cylindrical roller bearing has thrust capacity of from 10-15% of its rated radial capacity!



Figures 2 and 3 diagram the centerless grinding method used to finish Bower raceways. Use of this technique assures not only optimum roller guidance and maximum bearing life, but also virtually eliminates bearing runout. BEARING SYMMETRY WHICH RESULTS FROM THIS TECHNIQUE PERMITS ACCURATE SHAFT LOCATION REGARDLESS OF HOW THE OUTER RACE AND ROLLER ASSEMBLY ARE INSTALLED. IT COMPLETELY ELIMINATES THE POSSIBILITY OF IMPROPER INSTALLATION.



★ ★ ★ ★

Whatever your bearing needs, we suggest you consider the advantages of Bower bearings. Where product design calls for tapered or cylindrical roller bearings or journal roller assemblies, Bower can provide them in a full range of types and sizes. Bower engineers are always available, should you desire assistance or advice on bearing applications.

BOWER ROLLER BEARINGS

BOWER ROLLER BEARING DIVISION – FEDERAL-MOGUL-BOWER BEARINGS, INC., DETROIT 14, MICHIGAN

CIRCLE 30 ON READER SERVICE CARD

CIRCLE 31 ON READER SERVICE CARD→

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8 different AlSiMag compositions

Pressed AlSiMag ceramics . . .
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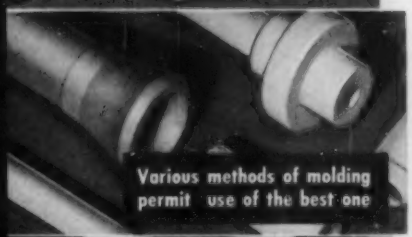
from one source . . .

These are typical samples picked up in our Inspection Department over a week end. They illustrate the great variety of technical ceramics constantly flowing through our ultra-modern plants.

Parts are shown approximately ½ size.

Property Chart Sent on Request.

Odd contours can be handled in specialized molding processes



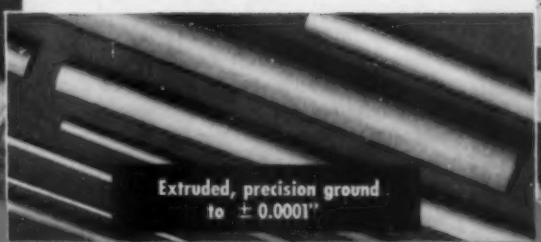
Various methods of molding permit use of the best one

AlSiMag metal-ceramic assemblies

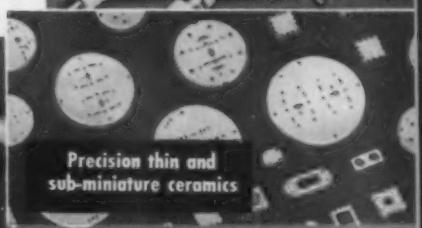
Casting handles larger shapes, odd contours

High temperature hermetic seals

Soft solder metalization



Extruded, precision ground to ± 0.0001"



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FOR YOUR INFORMATION (personal)

No inky pinky now

An optical system that catches and records fingerprints instantaneously—without subjecting fingers to smudgy ink or chemicals—has been developed by Chance Vought's Electronics Div. And, says CV, it should be adaptable to television or telephone line transmission for immediate checkup against centrally located master files.

Operating by a gentle touch of the finger on a small glass plate, it produces prints "so clear that pore structure of the ridge pattern appears without smudging or distortion." Shown here is the optical unit, and a projection of a print.

Electric car in your future?

Battery-operated vehicles offer the advantages of simplicity and reliability, and low maintenance cost. But even their most enthusiastic supporters admit first cost is likely to be high, battery size and weight may represent ½ or more of the car's total, and the period between battery charges may be very short indeed. Furthermore, as B. F. Bennett of GE pointed out to a recent AIEE meeting, even a 2% grade doubles the power required to overcome rolling resistance, stop-and-go driving may produce an excessive drain on the batteries (15 starts to 30 mph take nearly 10% of battery capacity), and low temperatures may cut battery capability in half. This alone may limit use of electric cars to warmer climates, or necessitate additional heating equipment.

Free copies of his paper, giving names of companies developing cars and data on performance, are available to those interested. Address: B. F. Bennett, Industrial Machinery Engineering, GE, 1 River Road Schenectady.

More lip service

Talking elevators and portable, transistorized intercoms for home use are among latest wonders of the Communications Age.

The elevators, installed in Hess Department store, Allentown, Penna, tell the customer where to stand and, by recording messages, feed information to her as she rides. She doesn't have to worry about a thing, Hess says proudly. Each elevator has an electronic proximity device which keeps the door from closing on her if she's too close to it. On the other hand, says Hess, "If a shopper tarries too long in the elevator entrance, the doors will take command of the situation, as they slowly close, politely but firmly nudging the shopper out.

The intercom, now in pilot production at GE's Utica plant, doesn't talk back to its users. But it does promote communication. It can be plugged into any 110-v outlet, and may even be used between houses, provided they have a common power-line transformer. Individual units are 7 by 7 by 5 in., weigh about 2 lb, have 4-in. speakers. "Suggested" price: $79.95.

Make it do—double

Convertibility will keynote consumer-product design for 1961 if advance showings are any indication. The product that can't do two things, or even three, will be behind in the race. It's not simply a matter of providing a reusable package; but of designing multiple attachments, removable housings that can stand by themselves (appliance covers that turn into trays, for instance), electric mops that apply water and detergent, scrub the floor, and vacuum off the excess—all at once; and, of course, mixers that also mince, and toasters that bake and broil. —ARG

The magic of our ingredients makes electric motors better...

Just as a good chef wouldn't use only one all-purpose spice to make a specialty...we don't make an electric motor with one all-purpose insulation.

We build motors with SELECTIVE INSULATIONS...

SELECTIVE INSULATIONS are the magic ingredients that make the difference between merely good motors—and the famous dependability, low maintenance, uninterrupted productivity, and prolonged service of Fairbanks-Morse electric motors.

We actually "tailor" a wide range of insulating materials and processes to motor applications, according to specific operating conditions. We never standardize to the average.

SELECTIVE INSULATIONS meet emergency overloads, temperature extremes, corrosive atmospheres.

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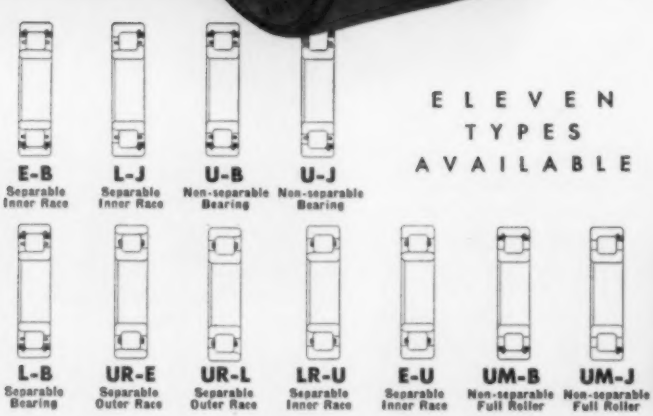
ROLLWAY Tru-Rol® BEARINGS

Give you more for your bearing dollar

For those hundreds of in-between applications where performance requirements are more exacting than those provided by the ordinary commercial bearing, but where maximum precision would be unneeded precision – specify Tru-Rol for the job.

Tru-Rol Bearings provide above-commercial-grade efficiency . . . at worthwhile savings in cost. Internal clearances are closely controlled. Rollers are equally spaced to eliminate out-of-balance vibration. Each roller is crowned to distribute the load evenly along the full length of the roller. Eleven types available in single and double width bearings, in stamped steel retainer, segmented retainer or full roller construction.



Ask your nearby Rollway Service Engineer to detail the quality you *should be getting* in your "commercial grade" bearings. Or write for the Rollway Tru-Rol catalog showing the full line, and capacity and size ranges. ROLLWAY BEARING COMPANY, INC., Syracuse, N. Y.

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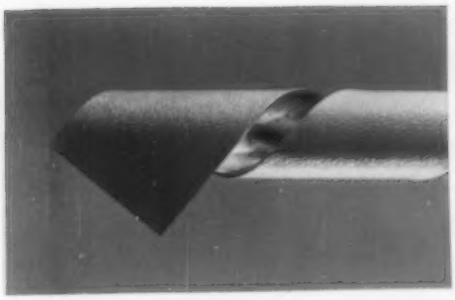
Twist it



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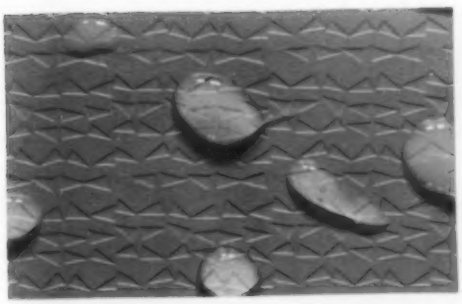

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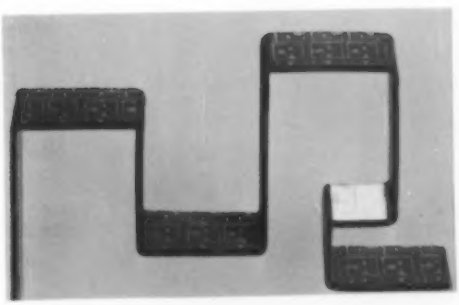

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Give you more for your bearing dollar

For those hundreds of in-between applications where performance requirements are more exacting than those provided by the ordinary commercial bearing, but where maximum precision would be unneeded precision – specify Tru-Rol for the job.

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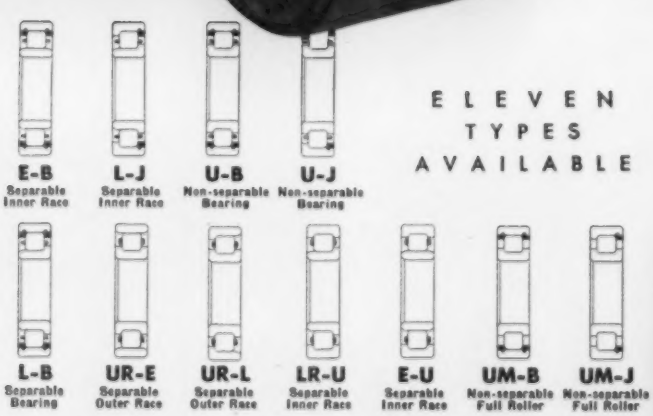

ELEVEN TYPES AVAILABLE

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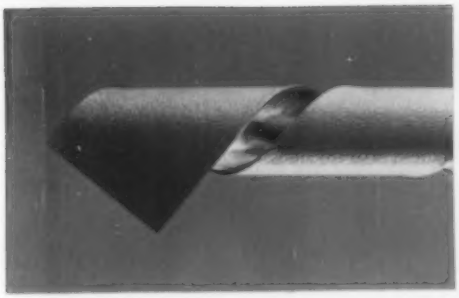

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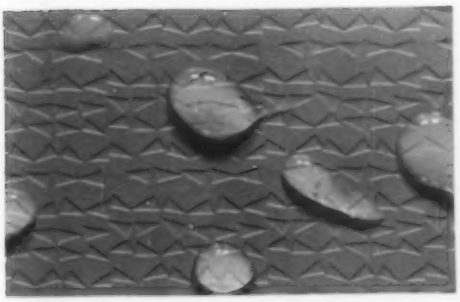

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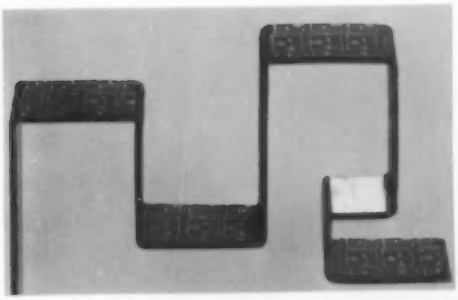
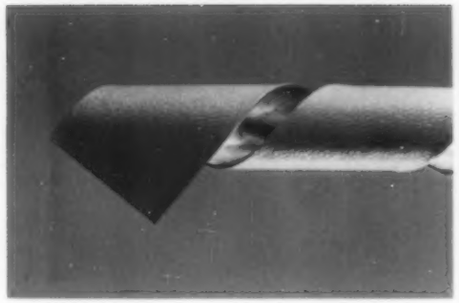


Design with it

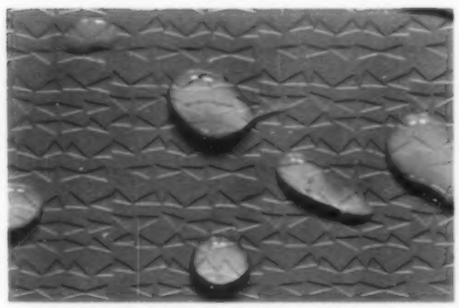
USS Vinyl Coated Steel Sheet ● Here is the look and feel of leather or fine cloth, or any other texture you want, bonded and cured directly and permanently to steel. Here is a complete spectrum of color, too, in a material that is inexpensive, versatile, tough enough to take the hard knocks and strong enough to be used in the most demanding applications. USS Vinyl Coated Steel Sheet is easy to clean, resists spotting and staining, can be fabricated easily and inexpensively. It opens up many design possibilities in both consumer and industrial markets. It offers these advantages:

Twist it The surface won't crack or peel. Here is tough vinyl that can be produced in any texture, any color, with the strength of steel.



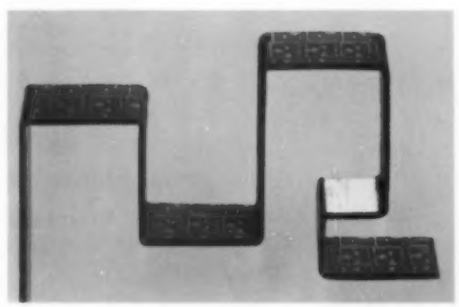
Four examples of the many patterns

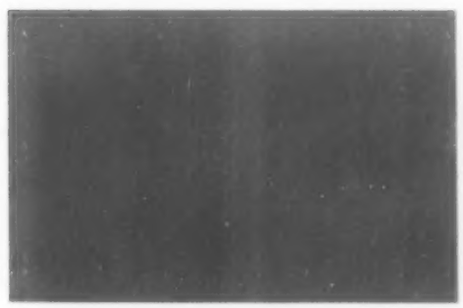
Wet it Try to spot it. USS Vinyl Coated Steel Sheet won't water spot. You can't stain it with die lubricants, alkaline cleaners, fountain pen ink, alcoholic beverages, detergents, acid cleaners, nail polish, or fruit acids.



which can be ordered

Form it You can slit it, punch it, draw or roll form it. USS Vinyl Coated Sheets can be lock seamed easily. Special processes have been developed so you can weld it with no damage or discoloration to the finish.



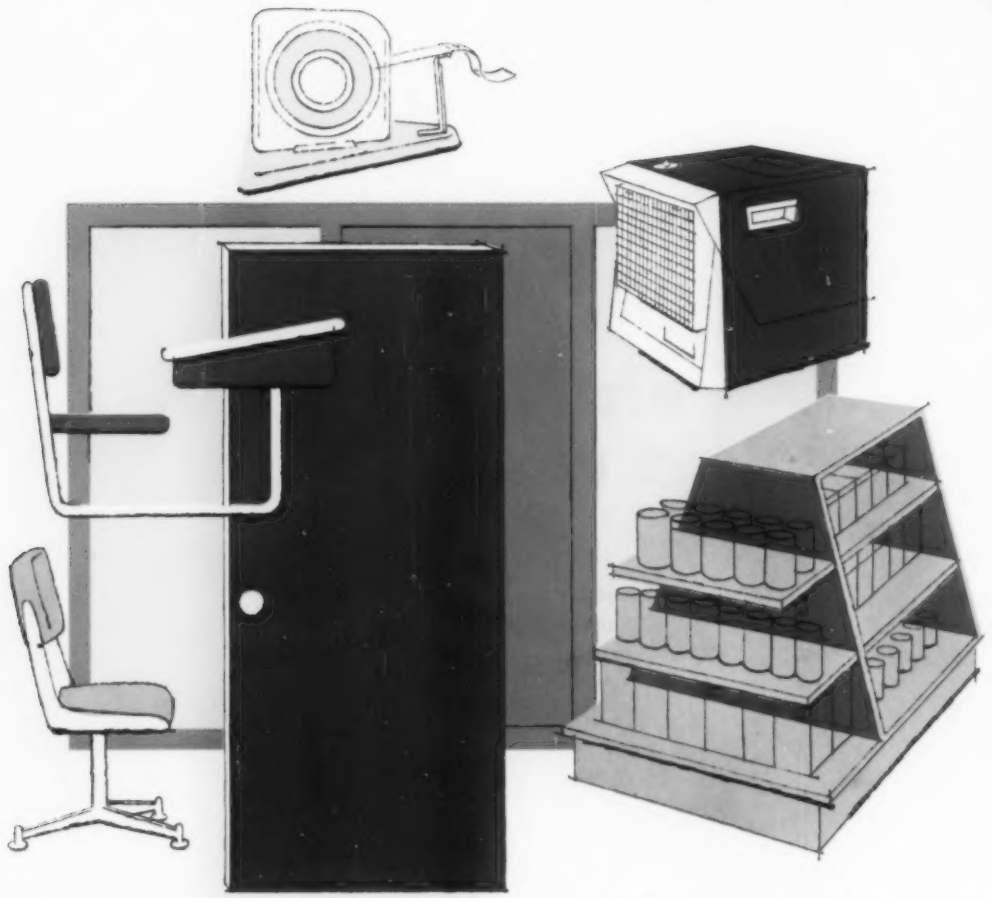


in vinyl coated steel.

Design with it Building interiors, doors, appliances, furniture, automobile and station wagon interiors, railroad car interiors, business machines, store shelving, switch panels, almost any product that is subjected to abuse.

USS TRADEMARK **Vinyl Coated Steel**

This mark tells you a product is made of modern, dependable Steel.



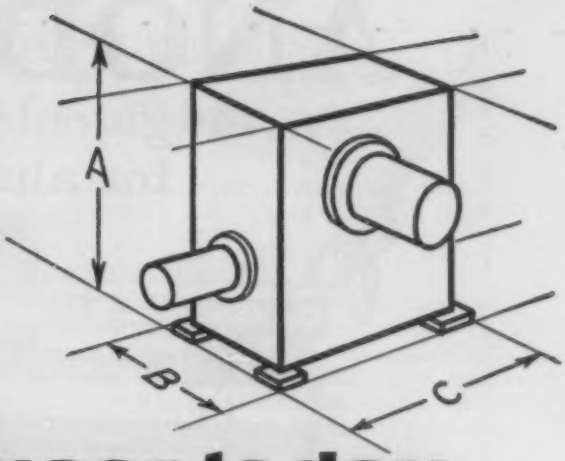
Here are just a few suggested applications for USS Vinyl Coated Sheets: A colorful room divider or partition. Face panels are interchangeable; panels of different colors or textures can be easily inserted. A portable space heater that is scuffproof, also available in any color or texture. A lobby door that defies scuffs and hand prints, is easily cleaned; color and texture can adapt to any interior decoration. For long term service, smart appearance with practically no maintenance, vinyl steel store shelving meets the requirements of heavy use in any color. Contemporary office chairs covered with USS Vinyl Coated Sheet that will last.They look and feel like leather; actually they're strong steel. A school desk that will take years of hard knocks, yet look like it's going through its first term. For the home, a tape dispenser with extra sales appeal because it has the look and feel of fine leather.

USS Vinyl Coated Sheets can be adapted to these and thousands of other uses. It is competitive in price with other materials. It will not support combustion and it has a dielectric strength of 750 volts per mil of coating thickness. It is available in gages from 16 through 32, widths from 24 to 52 inches, in coils up to 10,000 lb. Vinyl coatings are 0.008 to 0.020 in. thick.

Samples and technical assistance are readily available from U. S. Steel. Or send for our 20-page, full color technical book, "USS Vinyl Steel." Write United States Steel Corporation, Room 6125, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

USS TRADEMARK **United States Steel**

Do-It-Yourself...



Let's design a speed reducer today

So you can't find a speed reducer to fit your latest brainchild without ruining the design? Doggone manufacturers all build reducers too big to fit into those few cubic feet you've got left for the reduction unit back behind the double-ended dingbat?

Revolt! Design your own! Show 'em!

By George, design it yourself and it'll fit. How? Well, you know your size limits. Draw the biggest box that'll fit the space and you've got your reducer housing specifications.

Now you need gears that will (1) transmit the needed horsepower under all operating conditions, (2) provide the ratio your machine requires and (3) fit the space that's available. You'll soon discover that there are limits to what gears can do in transmitting horsepower. The cheapest answer is parallel shaft helical gears. If they'll fit you're in clover. But they take the most room, especially when you're out of the fractional hp range. The right angle worm and gear combination is the most compact drive arrangement.

Here again you have a choice. Cylindrical worm gearing is often used, and if it'll do the job, is worth consideration. But it's not the most compact possibility. The best way to shrink gears and still carry the load is the double-enveloping worm gear design. Both worm and gear are throated and the two literally wrap around each other. This brings center distance of the two shafts closer together and you can put them inside smaller housings.

Does this reduce load capacity? No sir! You can carry the same load with center distances up to 33% smaller than those of cylindrical worm gears. Or use the same center distance and carry a greater load. Will these gears hold up in operation? Sure, if you beef up the teeth, the bearings and the housing. Use straight-sided worm and gear teeth and you'll get all the strength there you'll ever need. Use large taper roller bearings with real B-10 life. Use a reinforced, heavy wall housing that won't distort under load. Put fins on it for added cooling and increased thermal horsepower capacity to meet your needs. Now, put the whole thing together and you've got a speed reducer that's a dilly.

Designing your own speed reducer give you a headache? Looking for an easier way? There is one. Someone's already done exactly what you're talking about. You can order that compact speed reducer right off the shelf. Where?

Cone-Drive Gears, that's where!

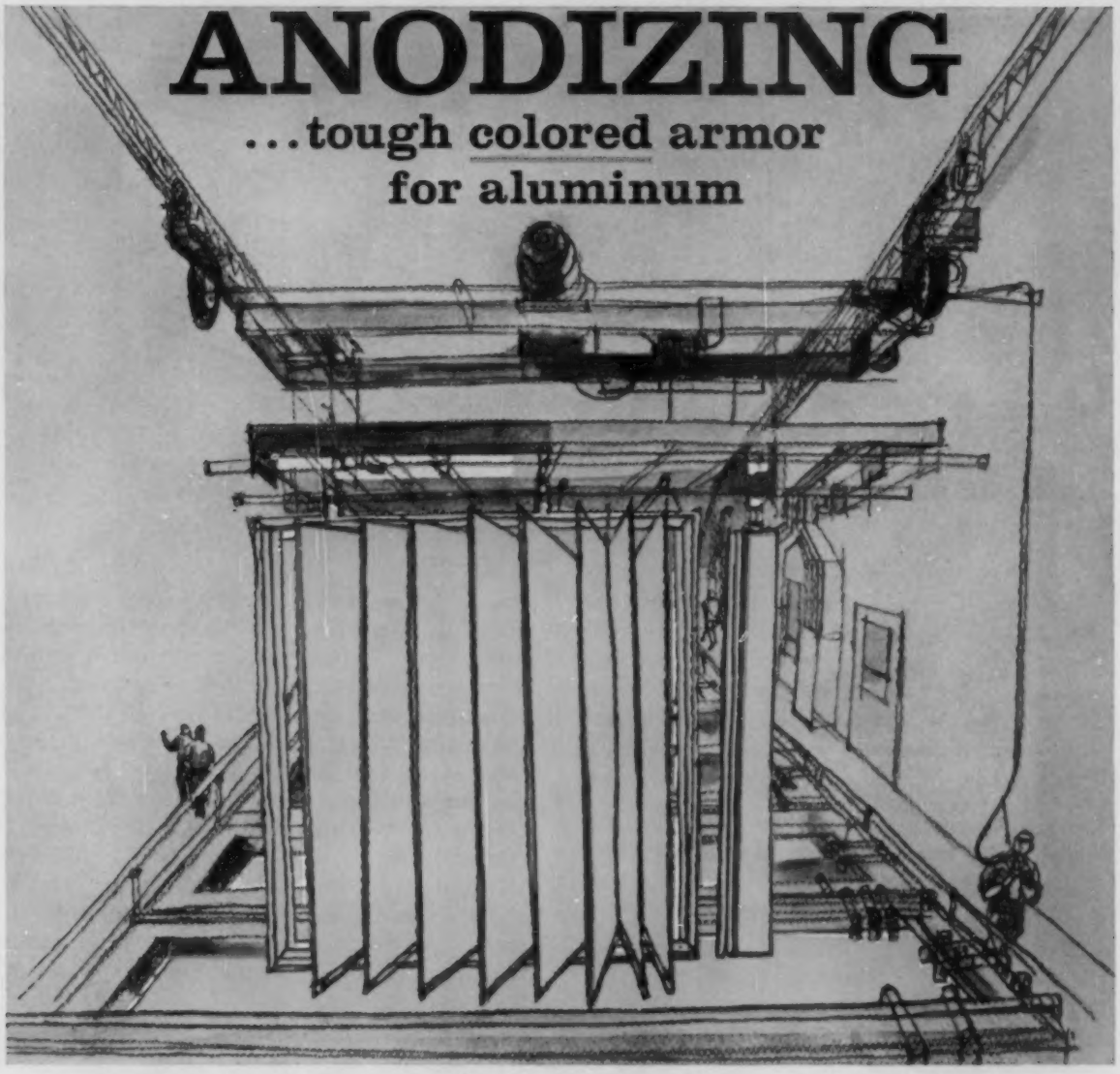
Yes sir. They stock double-enveloping worm gear speed reducers from fractional to 665 hp. Standard ratios from 5:1 to 70:1 in about 15 increments, all interchangeable in any type housing of a given center distance. Worms over and worms under. Gear shafts vertical, too. Single- or double-extended output shafts, or shaft mounted. Over 200,000 combinations possible. Wow! Just about anything you want.

Better get Cone-Drive's new speed reducer catalog that details everything. Ask for Bulletin CD-218. Cone-Drive Gears, Div. Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

CIRCLE 41 ON READER SERVICE CARD 41

ANODIZING

...tough colored armor for aluminum



Anodizing gives aluminum a hard, lustrous armor against abrasion, scratches, and weathering.

This thin, tough oxide film adds to aluminum's natural corrosion-resistance, and provides extra protection against weathering and abrasion. But the reason many designers and manufacturers are interested in anodizing is that it is an effective way to add clear, lasting *color* to aluminum products.

Because of its color, its resistance to weathering and corrosion, and its low maintenance features, anodized aluminum is used in more and more new buildings—indoors and out, structurally and decoratively. And it has found wide application in appliances, furniture, housewares, automobiles, and hardware, to name just a few uses.

With anodizing, you can select from a wide range of finishes—from bright, lustrous clear to soft matte finishes—from clear finishes to opaque greys. And these finishes are available in several colors.

The full anodizing process usually includes preliminary mechanical finishing, cleaning, etching or chemical brightening, anodizing, neutralizing, and sealing. The result: an aluminum finish that is extra-hard, extra-resistant to abrasion, corrosion, weathering, and wear—plus lasting, lustrous *color*.

Some of the important facts about anodizing are given on the next page. For complete details about the potentials and properties of anodized aluminum, or about Reynolds anodizing facilities, send in the coupon on the next page.

important things to know about anodizing aluminum

What Anodizing Is

Anodizing is the building of an aluminum oxide from .0008 to .001 in. thick on aluminum electrochemically. The aluminum part to be anodized is made electrically positive in an electrolytic bath, usually sulfuric acid.

What Anodizing Does

1. Provides a hard, abrasion-resistant surface on the aluminum
2. Preserves the natural sheen and appearance of aluminum
3. Increases the natural corrosion-resistance of aluminum
4. Enables you to add permanent colors to the surface of aluminum
5. Insulates aluminum surface against passage of electricity

How to Specify Anodizing

Always specify minimum anodic film thickness, not anodizing time. Film thickness can be checked by eddy current principle with accurate instruments available.

Film Thicknesses Recommended

Thickness of the anodized film will depend on product design and service requirements, but following are some average specifications:

Decorative anodizing	.00012"
Appliance parts	.0002
Automotive parts	.00025
Interior architectural	.0004
Maximum wear areas	.0008
Maximum color fastness	.0008
Exterior architectural	.0008

Color Anodizing

For architectural applications where fade-resistance is important, the best anodized colors are natural (clear), black, and several shades of grey and gold. For applications other than architectural there is a wide range of acceptable colors.

Anodizing Alloys

Various aluminum alloys affect the anodic films differently. Anodic films on alloys with smaller amounts of manganese, silicon, and copper will be clearer, less grey. Alloys with copper, lead, and zinc will be more difficult to anodize effectively. For decorative anodizing, the following alloys are recommended:

5005, 5357, 5457, 5557, 5657, 6063, 6463, RF-10, RF-15, RF-20

For bright anodizing, the following alloys are recommended:

5357, 5457, 5557, 5657, 6063, 6463, RF-10

Clear anodizing is recommended for casting alloys, the following alloys being best:

214, C-214, F-214, 218, 220

Dimensions Change

Anodizing will change the dimensions of a part . . . "normal" anodizing will increase the surface thickness by one-third the thickness of the anodic film; "hard" anodizing increases surface thickness by one-half the thickness of the film.

Anodizing Costs

Figure anodizing costs by the thickness of the film. Cost is usually quoted per square foot of one finished surface, although smaller parts are quoted per part. Anodizing on automatic equipment is usually most economical.

Anodizing Facilities

Reynolds has two large anodizing facilities which can handle parts up to 25 feet long and 12 feet wide. There are also many reputable anodizing firms throughout the country — the local Reynolds sales office can assist you in selecting one in your immediate area.

REYNOLDS ALUMINUM

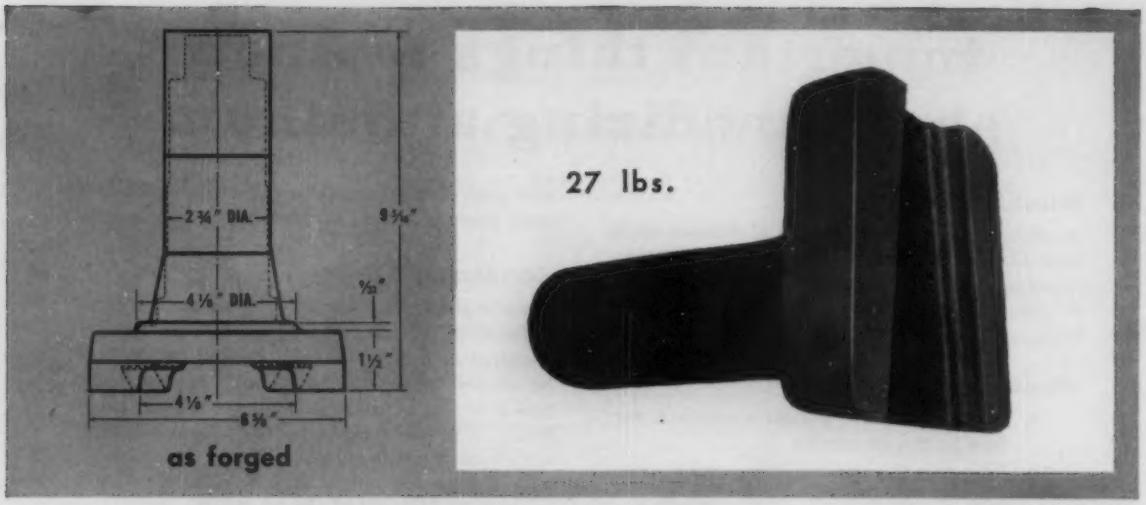
Watch Reynolds new TV show "Harrigan & Son", Fridays, starting October 7; also, "All Star Golf", Saturdays, resuming October 15—ABC-TV. And on Sunday, October 16, be sure to see the exclusive showing of America's new 1961 cars on The National Automobile Show, direct from Detroit over CBS-TV, 6 to 7 P.M. EDST.

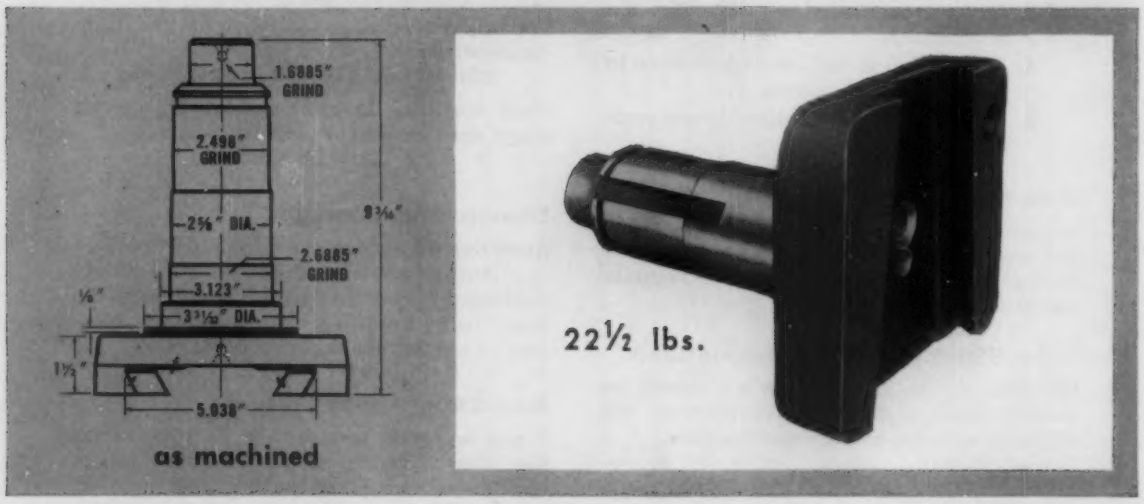
Reynolds Metals Company
P.O. Box 2346-HN, Richmond 18, Virginia

Please send me details on anodizing, and on the Reynolds anodizing services and facilities.

Name_____
Firm_____
Address_____
City_____ Zone____ State_____

CIRCLE 43 ON READER SERVICE CARD





New design idea cuts OEM part cost

COMMERCIAL upsets pedestal with off-center shaft and dovetail groove—cuts machining time...saves metal.

Key part in new multi-purpose tractor is this steering link pedestal, designed for fast front-end changeover via its dovetailed groove.

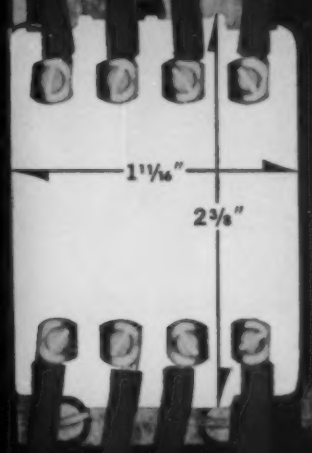
COMMERCIAL engineers working with the OEM proved that, despite the part's tricky dovetailed head and off-center shaft, it could be best produced as an upset forging. Precision manufacture on a 6" upsetter delivered the close tolerances necessary to save machining time and metal (forged weight 27 lbs.—machined weight 22½ lbs.). And, upset forging itself created the dense, tough metal structure to guarantee high tensile, high torsional strength...light weight ...less machining rejects.

When you're looking for ways to cut your own metal working production costs, consider upset forging by COMMERCIAL—backed by over 30 years experience in the field. Address inquiries to Commercial Shearing & Stamping Company, Dept. G-36, Youngstown 1, Ohio.

COMMERCIAL
shearing & stamping

CIRCLE 45 ON READER SERVICE CARD →

NEW MACHINE TOOL RELAY
cuts panel space

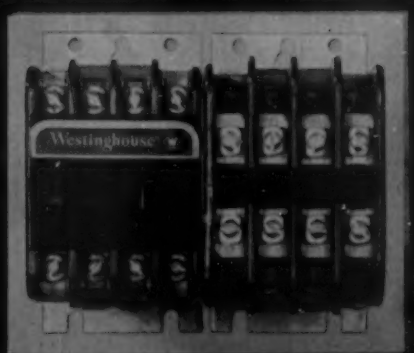


Actual size photo of machine tool panel

new machine tool relay cuts panel space 50%, reduces installed cost over 20%

ACTUAL SIZE

Machine tool relay is rated 6 amps, 300 volts a-c, from 2 to 8 poles in 2 basic frames. Relays can be butted against each other to save space.

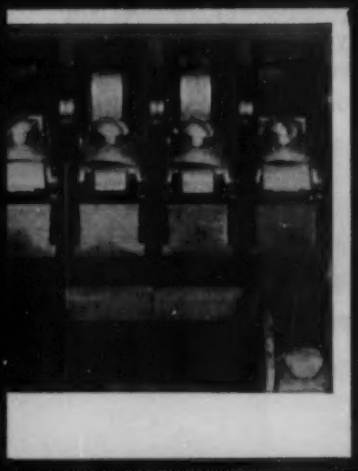


Here's the new Westinghouse relay that cuts the control panel space requirements as much as 50%. Specifically designed for use on automated machine tools, this relay is smaller than any other similar unit available. Relays can be butted against each other in banks. What's more, both 4 and 8 pole frames have the same mounting dimensions, occupy the same panel area, and can be mounted adjacent to each other without additional electrical clearances. ■ Wiring a panel is easier, too. Relay terminals are all readily front accessible. Each of these clamp type connections has a wire stop . . . installation is faster and costs less. You actually save more than 20% over outdated relays. ■ This new relay has load rating of 6 amps, 300 volts a-c—found by experience to be ideal for most of the machine tools now being designed. ■ Want more information? Contact your nearest Westinghouse representative or write: Westinghouse Electric Corporation, Standard Control Division, Beaver, Pa. Remember: You can be sure if it's Westinghouse.

See this relay in action on machine tools at the Production Engineering Show in Chicago—September 6 through 16.

Clamp type terminals are front accessible and will accept #14 to #18 stranded wire

J-30318



Westinghouse

Masland Duran CLAD on the
Frigette Auto Air Conditioner by
FRIGIQUIP CORPORATION
Oklahoma City, Oklahoma

Helps speed production . . . and product sales, too

Masland Duran
CLAD
vinyl finish

This versatile vinyl can be laminated to metal to provide a built in finish that eliminates dipping, spraying, coating, etc. It can be cut, crimped, drilled and even deep-drawn without impairing its colors or designs. Easy to clean colors. A powerful competitive advantage for *your* product.

Write for information and samples . . . and the name of the laminator in your area.

Industrial Products Division
THE MASLAND DURALEATHER COMPANY
Dept. PE, Amber & Willard Sts., Philadelphia 34, Pa.

A real self-drilling screw!

P-K Tapits actually *drill* their way into light gage sheets when driven with a power driver! You eliminate hole drilling or punching with this newest idea in tapping screws from Parker-Kalon... speed sheet metal assemblies up to 50%

What's more, P-K Tapits have a serrated washer, integral with the head, that minimizes stripping, by acting as a built-in brake.

Production line tests with millions of P-K Tapits prove these advantages you get with no other screw:

Unique drill point—Tapits start drilling immediately! The cuneiform (pyramid-type) point prevents walking, skidding or creeping!

Uniform Hex Head—Same size hex head on the entire range of Tapits from #6 to #10 means you need only one size driver socket. Sharp corners, well-filled driving faces reduce socket wear.

Advanced washer design—the serrated washer scientifically distributes driving stresses . . . minimizes stripping.

Sharp-crested threads—Holes drilled by P-K Tapits are exactly root diameter. Tapits hold far better because thread in engagement material mates perfectly.

Properly hardened—P-K's exclusive laboratory-controlled hardening and tempering process results in a uniformly hardened screw with a tough core.

USE P-K'S MAGNETIC DRIVER SOCKET FOR POWER DRIVING!

You need only one size driver socket to drive any P-K Tapits! Get the P-K driver socket with a strong Alnico magnet that firmly holds the Tapits. Fits any ¼" driver with adjustable clutch. Socket can be refaced to extend life.

PARKER-KALON®

originator of the tapping screw

PARKER-KALON, a division of General American Transportation Corporation, Clifton, New Jersey. Offices and warehouses in Chicago and Los Angeles.

P-K® TAPITS

Pat. Pending

TEST P-K TAPITS FOR YOURSELF! ASK YOUR DISTRIBUTOR FOR FREE SAMPLES

CIRCLE 49 ON READER SERVICE CARD

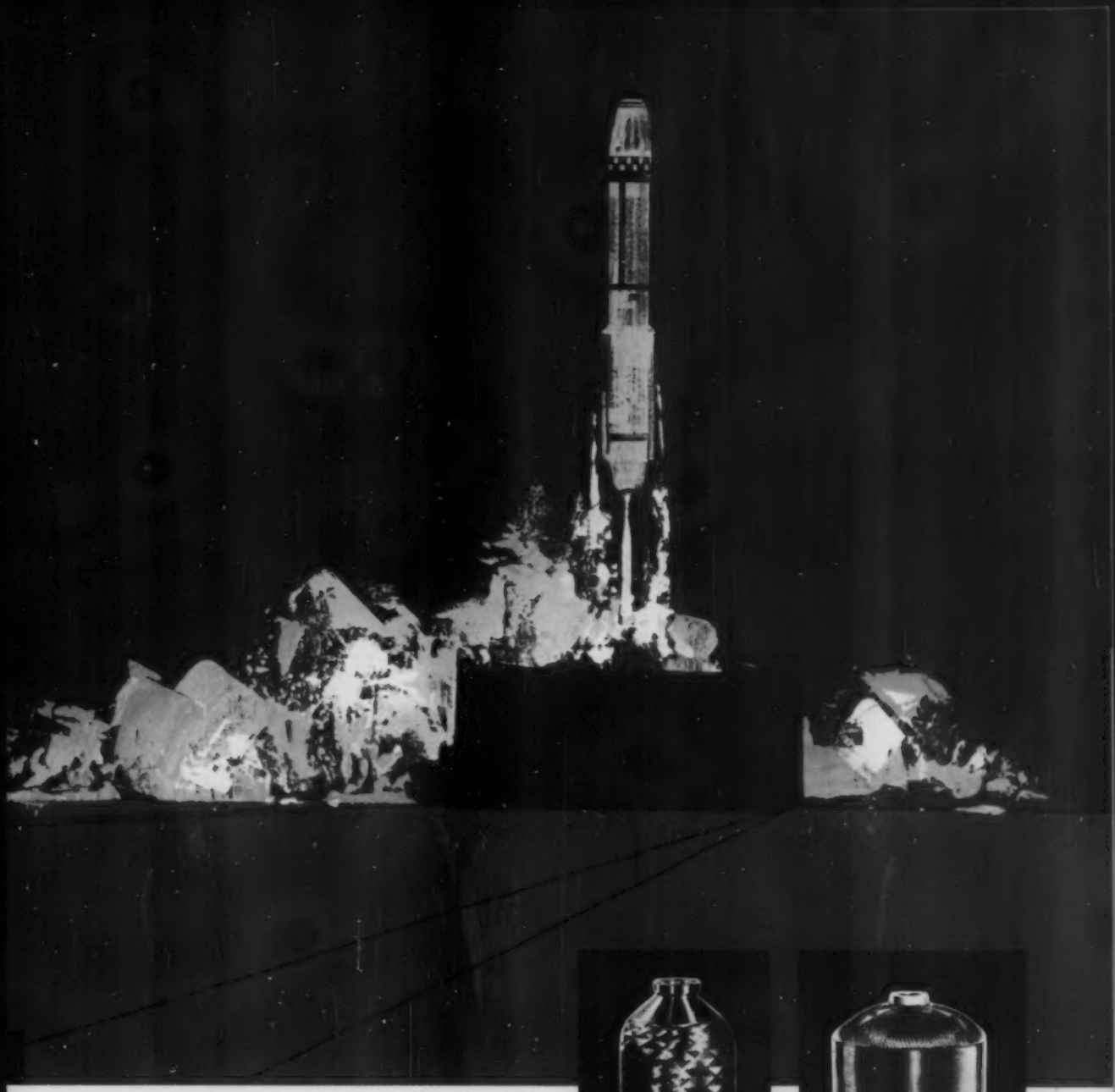
CIRCLE 50 ON READER SERVICE CARD→

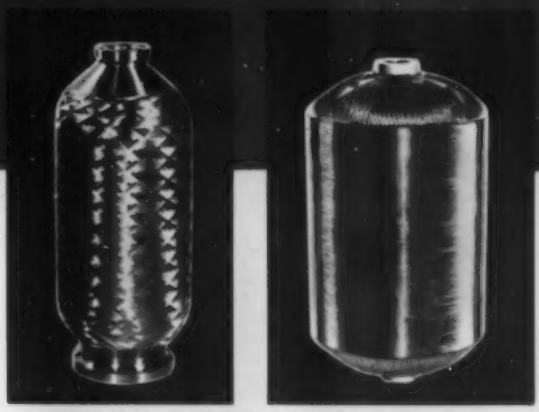
NS SPECIAL WIRE (575,000 psi) WRAPS

In the development of solid-fuel rocket cases, a leading manufacturer fabricated and experimented with welded steel and glass fibers, as well as many steel wire specimens, to find a fuel case material with the most favorable strength-to-weight ratio for fuel case applications.

EARLY DEVELOPMENT STAGES—At the outset of their testing program, the rocket manufacturer asked National-Standard to develop .004″ wire with 575,000 psi, the ultimate tensile strength required of steel wire to provide the strength-to-weight ratio needed. The wire was to be made into tapes of uniformly-stressed wires, coated with epoxy resin to separate the wires, and wound over collapsible mandrels to form the fuel case.

NATIONAL-STANDARD ENGINEERS produced .004″ high-carbon steel wire that met every specification, after intensive testing with many types of wire and finishes. Special wire developed by NS met rigid size tolerances, residual twist and controlled cast requirements.





WIRE-WRAPPED ROCKET CASES are wound over collapsible mandrels using a number of strands of very high strength, small diameter wire formed into tapes.

ROCKET FUEL CASES

The end result of NS—customer cooperation was the ability to produce wire-wrapped rocket cases with very high hoop stress and lower cost than those being produced by other methods. And the fuel case manufacturer is able to provide maximum case-to-case reliability.

EXPERIENCED ENGINEERING HELP of this kind is available to you from National-Standard to meet special or unique high-quality wire applications. Write for additional information to National-Standard Company, Niles, Michigan.

NS NATIONAL-STANDARD COMPANY

Manufacturer of Specialty Wire and Metal Products

NATIONAL-STANDARD COMPANY

Niles, Michigan

CASE HISTORIES

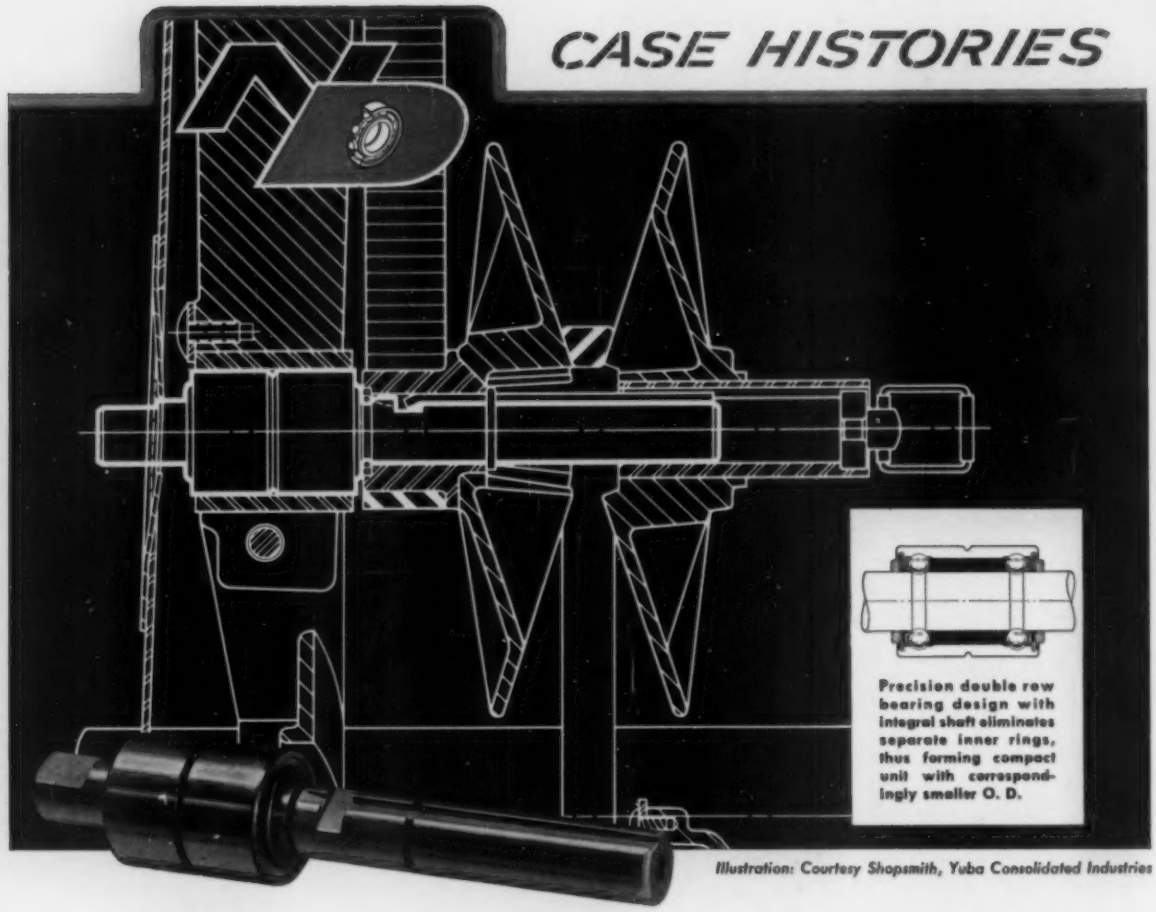

Precision double row bearing design with integral shaft eliminates separate inner rings, thus forming compact unit with correspondingly smaller O. D.

Illustration: Courtesy Shopsmith, Yuba Consolidated Industries

N/D Bearing Solves Home Power Tool Speed Changing Problem!

CUSTOMER PROBLEM:

Require low cost, compact idler shaft assembly for speed changer in popular, multi-purpose home power tool. The assembly must mount on ball bearings . . . operate at speeds up to 6000 RPM.

SOLUTION:

N/D Sales Engineer, cooperating with customer engineers, recommended a *single* N/D ball bearing —a compact integral shaft unit designed as part of idler assembly. The unit permits one of two interlocking variable pitch pulley halves to slide axially on shaft when changing pitch at high speed. This precision, automotive type fan and water pump bearing eliminates extra parts inventory and shaft machining . . . reduces assembly time. In addition to solving complex design problem, N/D's compact heavy-duty ball bearing is integrally sealed for protection against saw-generated dust . . . and lubricated-for-life for added end user sales appeal!

If *you're* designing new equipment, why not call your New Departure Sales Engineer. He probably can help engineer your application with a standard, volume-produced N/D ball bearing that will help solve your bearing problem. For more information contact New Departure Division, General Motors Corporation, Bristol, Connecticut.

Replacement ball bearings available through United Motors System and its Authorized Bearing Distributors.

NEW DEPARTURE

BALL BEARINGS

proved reliability you can build around

PRODUCT ENGINEERING **HORIZONS**

AUGUST 29, 1960

meet the european engineer

Postwar developments prove beyond question that this is a technological world. Engineers in particular repeatedly make the point that invention is essential to progress. Yet Americans are applying for patents at only a third the rate of the Swiss, half the rate of Swedes or West Germans (*PE—July* 18, p 75). While our organized R & D effort has increased about tenfold in dollars in the past 20 years, the number of patents issued has stayed roughly constant, as has the percentage issued to corporations. Apparently, our emphasis on R & D has not stimulated invention markedly, if at all.

It is a common belief that many of our new ideas come from overseas, that most of our really new products "have an accent." Therefore, industry has been scouring Europe for innovations, as well as investing billions in European plants to take advantage of lower labor costs and ease of entry into overseas markets. Yet the flow of technology particularly in the newer fields, has been *from* the United States rather than *to* it. Why this seeming paradox?

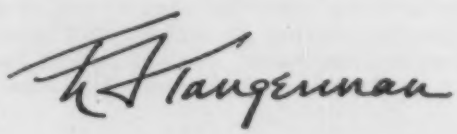
The same situation exists in government. We have poured billions into foreign aid and foreign bases, without either winning friends or influencing people. It is increasingly evident that money alone is *not* the answer.

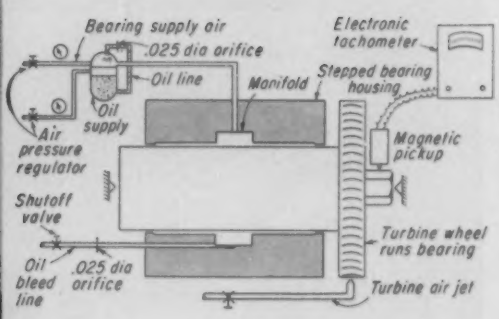
Well, then, what are the answers? Some indications may be found by talking with Europeans, especially engineers. So that's what we've done. We have interviewed about a hundred in their own countries, emphasizing in our questions the *engineering* effects of the Common Market. The results are in this issue.

Europe is booming like it never has, undergoing a present-day version of the Industrial Revolution. Our postwar aid was the first stimulus, the example of our standard of living was the second. But the current and most powerful one is the visible effect of industrialization and the potential it offers. Western Europe realizes that only by submerging nationalism in a Pan-European cooperative economy can it build big markets, hence big industrial plants with their resources for expansion and research. Having the increasingly industrialized and aggressive Soviet Union at the doorstep gives the whole process urgency. This the European engineer sees quite clearly. So do businessmen, diplomats, and an increasing number of the people.

The European engineer plays an important part in all this. He differs markedly from his American counterpart, even though we have common ancestry, because his traditions and his environment maintain differences. In countries where university degrees are still the exception rather than the rule, he has great prestige and social position. He reads and speaks several languages; he must to keep up, because his own country is relatively small—Switzerland's nationals could just about populate Chicago. He tends to delve deeply into his specialty, not to spread as widely as we do.

Yet he is much more conscious of politics and economics, which he knows affect his life and his livelihood directly. He and his ancestors have lived amid wars and threats of wars, so he is inclined to go ahead with his work regardless, and to live each day as it comes. He is interested in us as an economic power; our standard of living is his envy and his goal. He is competing with us consciously and strongly, but—and this is important—his competition is friendly and cooperative. So he is a man worth talking to and understanding.





now...
OIL-MIST LUBRICATION FOR AIR BEARINGS

Its boundary film may be the answer when air pressure alone is insufficient to prevent metal-to-metal contact. Best results so far are with the step-type bearing, shown above under test.

C R ADAMS, *research engineer*
Boeing Airplane Co, Seattle

Here's a way to prevent galling or seizure in an externally pressurized air bearing. It is done by blowing oil into the air supply and depending on the resulting mist to leave a thin film on the shaft and journal. This film of oil acts as a boundary lubricant and prevents metal-to-metal contact during operation or shutdown. The oil-to-air ratio is not critical, and the oil can be recirculated. But good results have only been obtained so far with air bearings of the step type. Three versions of the step bearing are illustrated at top of facing page.

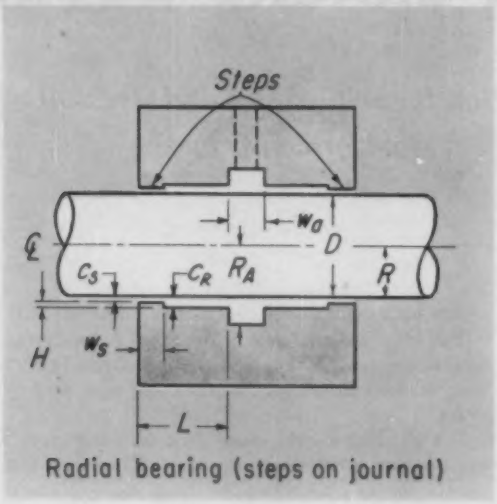
Step bearings are a recent Boeing development (see "The Step Bearing—a New Concept in Air Lubrication," Dec 8 '58, p 56). Key to their success is the steps or "dams" which are machined on either the shaft or journal. The steps are only 0.0003 to 0.001 in. high (they are exaggerated in the illustrations.) They throttle the gas when it is leaving the bearing—rather than when it enters, as do most externally pressurized gas bearings. This bearing differs from the "step bearing" developed by Lord Rayleigh. In the Rayleigh bearing, the step helps form a self-acting pressure wedge, while in the Boeing concept, the step is parallel to the direction of motion and serves as a throttling device for externally supplied pressure.

The Lubrication System

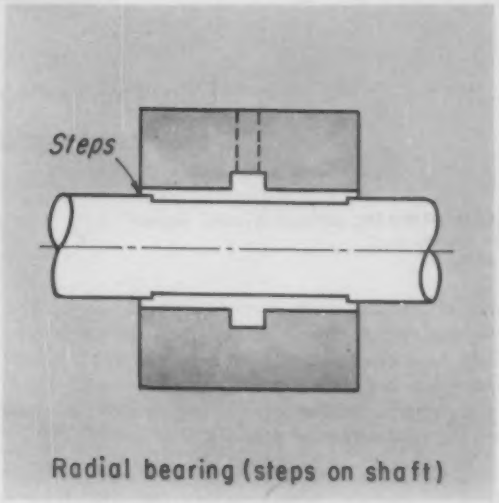
Creating the oil mist is simple enough. Schematic of the new lubrication system for a step bearing (driven by an air turbine) is illustrated above. Line *1* supplies the lubricating air at air bearing pressure. Line 2, at a higher pressure, forces oil to the top of the oil container and into the air stream of line *1*, where it breaks up into droplets. The resulting mist is carried on into the annular manifold that supplies the bearing.

It is also possible to flood the bearing with oil by closing the valve of the oil-bleed line. Step bearings are capable of operating with oil under pressure. This increases the load capacity but the viscous drag becomes extremely high compared to operation with air. For example, the air turbine drive which acts as the power source is adjusted to drive the shaft at 10,000 rpm for test purposes. Flooding the

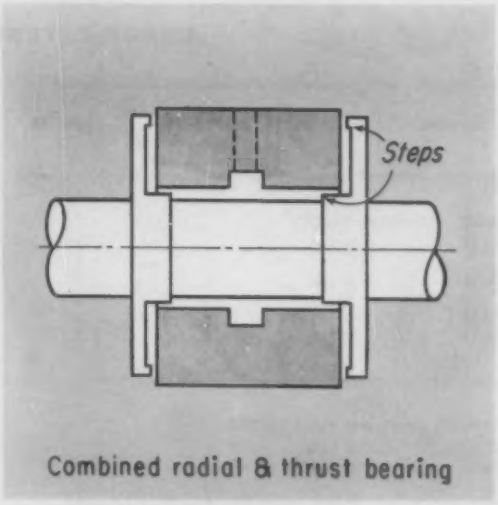
THREE VERSIONS OF THE STEP BEARING



Radial bearing (steps on journal)



Radial bearing (steps on shaft)



Combined radial & thrust bearing

bearing with oil abruptly drops the speed to slightly over 100 rpm. Opening the shutoff valve allows the gas to quickly blow out the oil and the shaft to accelerate rapidly to its original speed.

For normal operation, the bleed line is left open and the oil mist is bled off continuously. The bearing then operates as a normal air bearing. It is possible also to recover the oil for recirculation.

Permits Shaft Unbalance

Tests under cyclic operation (rapid stop and go) showed that galling and wear are reduced considerably with oil mist. Of greater significance is the ability of the mist to allow a 2-in. shaft with over 1 oz-in. of unbalance to operate for hours at 10,000 rpm without difficulty. Otherwise, turbine equipment must be balanced to 0.01 oz-in. or better. A 1 oz-in. unbalance normally would cause seizure in less than a minute.

Wider Choice of Materials

With oil mist, selecting materials for shaft and bearing becomes less critical. A small turbine with an AISI 4340 shaft and housing has been operated with and without oil in the bearing air-supply line. With the mist, intermittent contacts could be tolerated without difficulty. Severe galling of the step and rapid failure occurred when intermittent contact was made without the protection of the oil film.

DESIGN RECOMMENDATIONS

Step bearings have been built in shaft sizes ranging from 0.5 in. to 3.125 in. dia. Size is not a limitation. The bearings have operated satisfactorily at speeds to 100,000 rpm.

Here are the latest recommendations (also refer to illustration above) for determining dimensions and load capacity. These have been updated since they were first published in PRODUCT ENGINEERING.

D — Shaft dia, is usually selected first; $D = 2R$

L — Length from annular pressure manifold to outside edge of of step — should be about $0.7D$

w_o — Width of manifold — can be any convenient value over 0.05 in.

R_A — Radius at manifold — should be at least 0.1 in. larger than R

C_s — Radial step clearance — should be 0.0004 to 0.0008 in.

H — Step height — can vary from 0.0003 to 0.001; bearing stability improved with lower step heights; make steps sharply defined and parallel

w_s — Width of step — depends on ratio, C_s/C_R, which should be 0.4 to 0.7. For ratios of 0.4 to 0.5, $w_s = 0.025\ D$; for ratios of 0.6 to 0.7, $w_s = 0.07$ to 0.08.

For a given load capacity, the air-supply pressure during starting can be estimated from the equation:

$$P = 5\ W/LD$$

where P = supply pressure, psi; W = load, lb.

After the shaft builds up speed, the pressure can be reduced; in fact, at the higher speeds the shaft may completely support itself hydrodynamically.

EDITOR'S NOTE—In addition to the article on step bearings cited above, see:

Experts Strip Mystery from Gas Bearings, Nov 23 '59, p 68—staff report on the first international symposium, held in Washington, DC.

nomograph shows WHEN CRACKS BECOME

Chart solves equation for critical size and stress at which cracks in metal sheet start growing fast.

MALCOLM NEWMAN, *principal structures engineer*
Republic Aviation Corp
Farmingdale, NY

Cracks in stressed sheet or plate grow slowly at first, but on reaching a critical length they spread rapidly. Similarly, for a crack of any given length there's a critical stress at which it will start growing faster.

The nomograph on the opposite page solves this equation for the crack-extension parameter:

$$Edw/da = \sigma^2 \pi X (2 + y^4)/(2 - y^8 - y^4)^2$$

It can show either critical length or critical stress; and covers both central and edge cracks under uniaxial stress.

Full cross-sectional area of the sheet is gross area. Gross area minus crack is net area. This formula holds true as long as stress in net area remains less than 60% of yield stress.

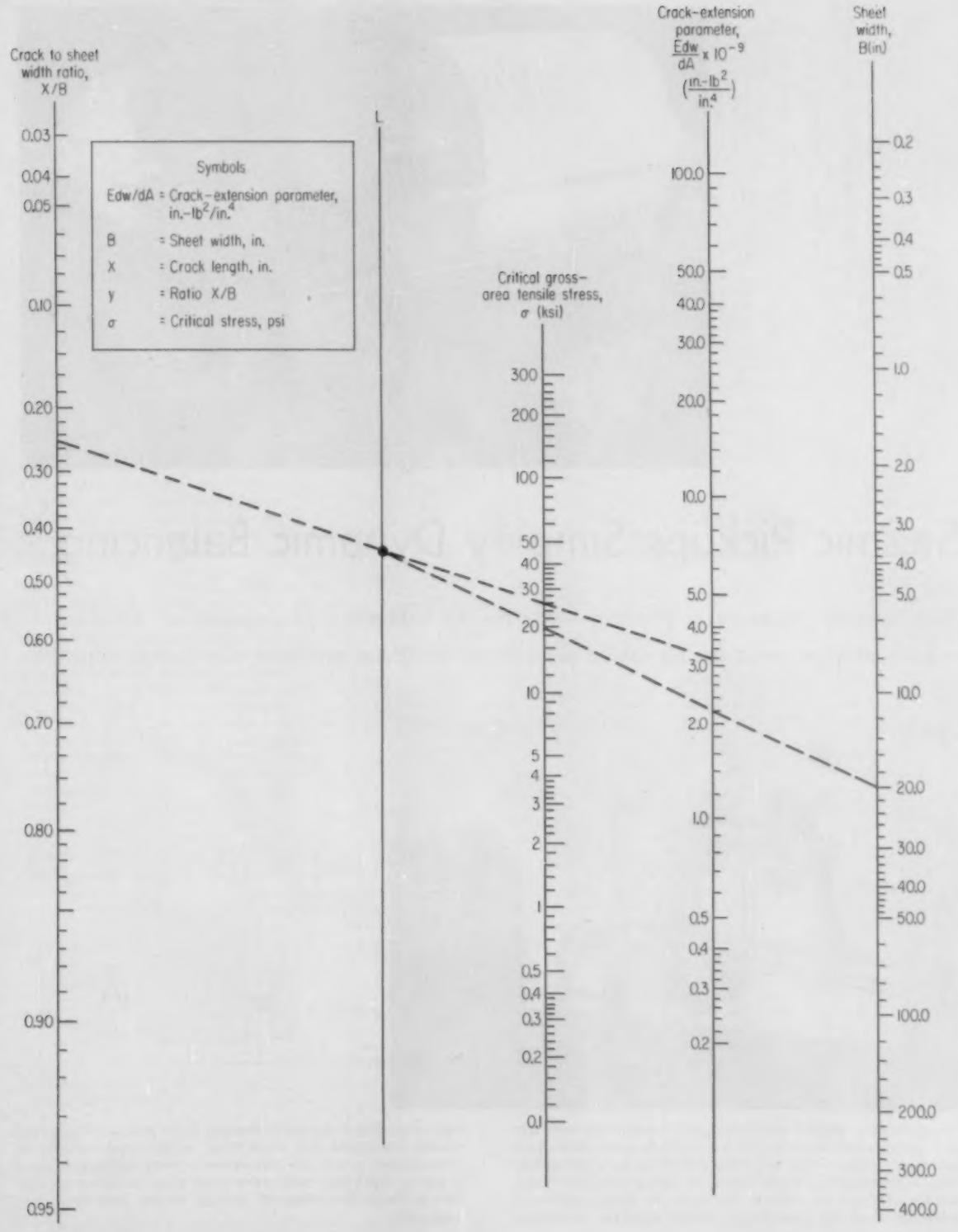
For all sheet widths more than 10 times crack length, critical stress is practically the same. Therefore, to find an answer for an infinitely wide sheet, use any sheet width more than 10 times crack length.

CRACK-EXTENSION PARAMETER

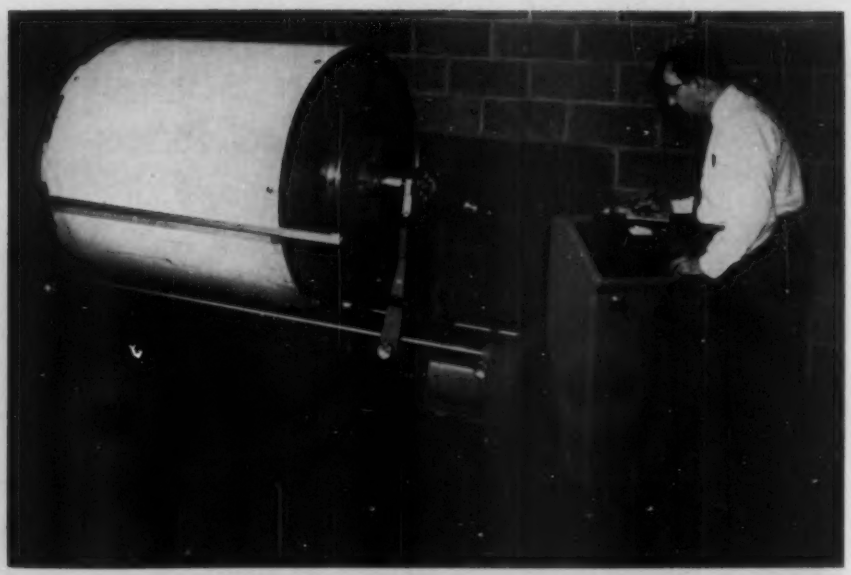
Material	Thickness, in.	Grain Direction L = Longitudinal T = Transverse	Edw/dA
FORGED ALUMINUM ALLOYS			
2014-T4	0.160	L	3.7
		T	2.7
2014-T6	0.160	L	4.3
		T	1.8
7075-T6	0.160	L	2.0
7079-T6	0.160	L	5.2
ALUMINUM SHEET and PLATE ALLOYS			
X2020-T6	0.160	L	0.5
2024-T3	0.032	L	4.0
		T	3.2
	0.064	L	6.0
		T	4.3
	0.091	L	6.1
		T	5.0
	0.25	L	4.0
		T	3.5
7075-T6	0.032	L	4.0
		T	3.7
	0.064	L	3.2
		T	2.4
	0.091	L	2.6
		T	2.1
	0.25	L	2.0
		T	1.1
	0.50	L	1.0
		T	1.0
7178-T6	0.032	L	2.3
		T	1.7
	0.064	L	1.9
		T	1.5
	0.091	L	1.4
		T	1.3
	0.250	L	1.0
		T	0.8
	0.58	L	0.8
		T	0.7

Material	Thickness, in.	Grain Direction L = Longitudinal T = Transverse	Edw/dA
MAGNESIUM			
FS-1H	0.032	L	0.8
		T	0.7
	0.064	L	1.0
		T	1.1
	0.091	L	1.4
		T	1.4
TITANIUM			
C110M	0.040	L	28.0
as received		T	7.6
	0.100	L	29.0
		T	2.1
	0.250	L	8.5
		T	8.0
6A1-4V	0.036	L	15.0
as received		T	23.3
LOW-ALLOY STEELS			
1020	0.066	L	9.6
		T	9.0
4330	0.030	L	22.8
Modified		T	23.1
220,000 psi	0.040	L	25.0
		T	24.3
STAINLESS STEEL			
17-7PH	0.025	L	12.0
THD 1050	0.049	L	9.2
	0.049	L	16.4 @ 600 F
	0.061	L	33.6
		T	21.0
17-7PH RH1075	0.047	L	36.5
17-7PH RH950	0.050	L	22.8
AM 350 Sct	0.027	L	45.6
		T	50.6
	0.050	L	19.4
		T	12.1 @ 600 F
Type 301 F. H.	0.077	L	50.1
	0.081	L	95.0
Type 302	0.081	L	6.1
Annealed			
Type 422	0.032		33.9

DANGEROUS

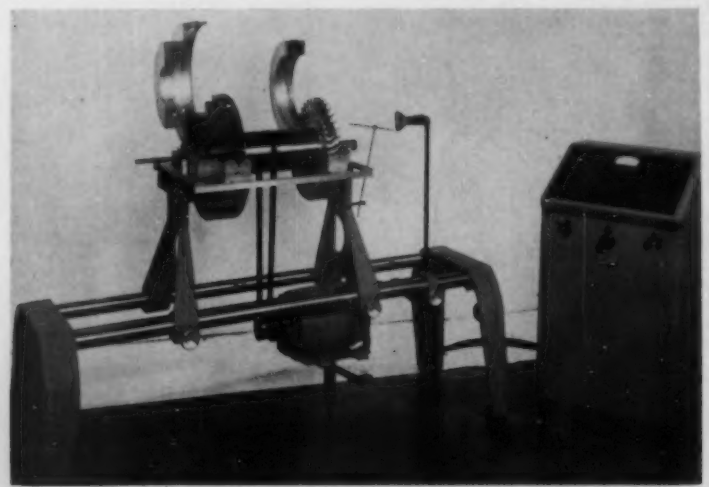

Crack to sheet width ratio, X/B
0.03
0.04
0.05
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
0.95
Symbols
Edw/dA = Crack-extension parameter, in.-lb²/in.⁴
B = Sheet width, in.
X = Crack length, in.
y = Ratio X/B
σ = Critical stress, psi
L
Critical gross-area tensile stress, σ (ksi)
300
200
100
50
40
30
20
10
5
4
3
2
1
0.5
0.4
0.3
0.2
0.1
Crack-extension parameter, Edw/dA x 10⁻⁹ (in.-lb²/in.⁴)
100.0
50.0
40.0
30.0
20.0
10.0
5.0
4.0
3.0
2.0
1.0
0.5
0.4
0.3
0.2
Sheet width, B(in)
0.2
0.3
0.4
0.5
1.0
2.0
3.0
4.0
5.0
10.0
20.0
30.0
40.0
50.0
100.0
200.0
300.0
400.0

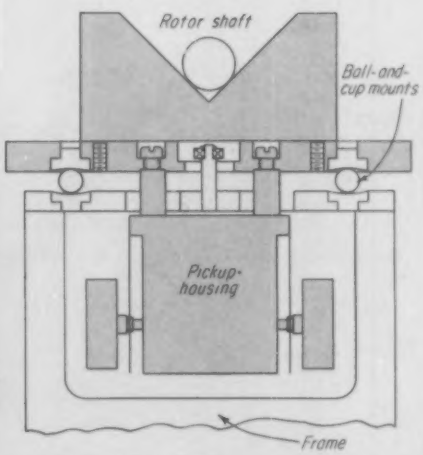
PRODUCT DESIGNS



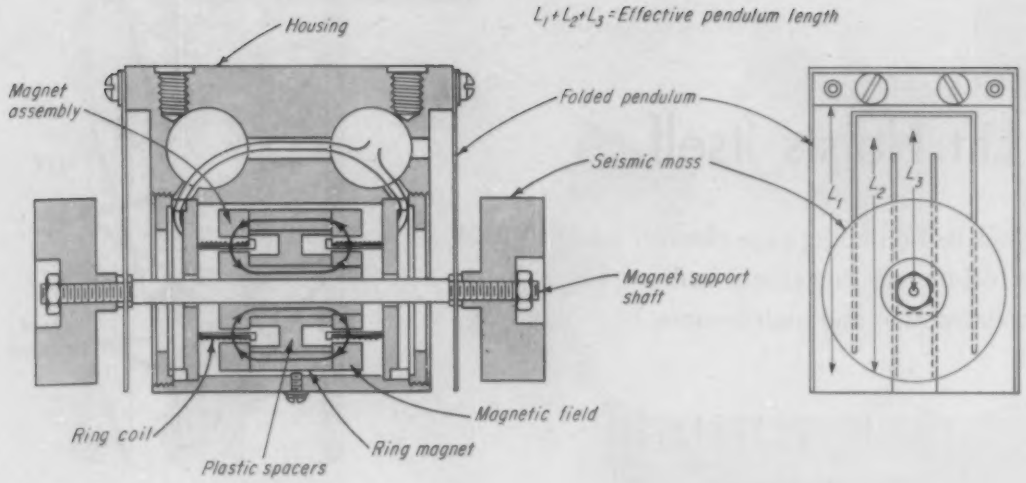
Seismic Pickups Simplify Dynamic Balancing

This dynamic balancer is portable—requires no hold-down or foundation. Its dual seismic pickups, mounted on folded pendulums, eliminate problems of external vibration.



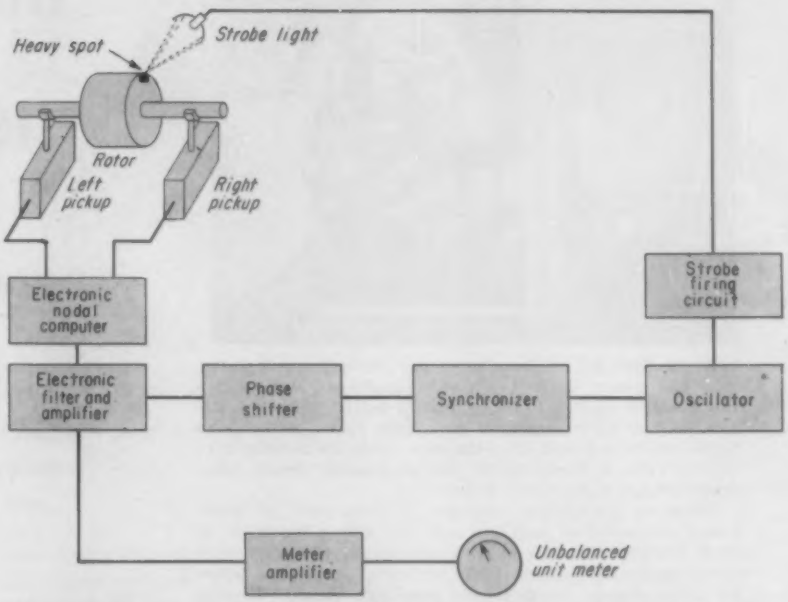


WORKPIECE BEING BALANCED is carried on two ball-and-cup-mounted work supports which can move freely in a horizontal plane. This provides low resonance of suspension, high capacity, small deflection under load, and high degree of freedom. Signal produced by shaft motion is transmitted to the console by seismic pickups, suspended from each work support. Such a light frame is possible because the reference base, from which rotor unbalance is measured, is not the frame but a freely supported mass in space. Frame or floor vibrations have no effect on the system since the vibration pickup senses horizontal motions only.



PICKUP contains two coils mounted in axial alignment and wound to magnetically oppose each other so that external magnetic fields have no effect. An Alnico ring magnet is suspended on folded pendulums at each end. Vibration of the unbalanced rotor produces horizontal movement of the coils in the magnetic field. Resulting current is fed to the electronic circuits in the console and amplified to produce a reading shown in unbalance units.

The effective length of the folded pendulum is L1 + L2 + L3 which provides a low-resonance suspension in minimum space. The pendulum also neutralizes the oscillations through an arc at the point of the magnetic support, keeping the magnet concentrically aligned with the pickup coils. Soft-iron rings and a plastic spacer are used to create a magnetic circuit with a circular gap at each end. Additional inertia is provided by the seismic mass mounted at each end of the magnet support shaft.

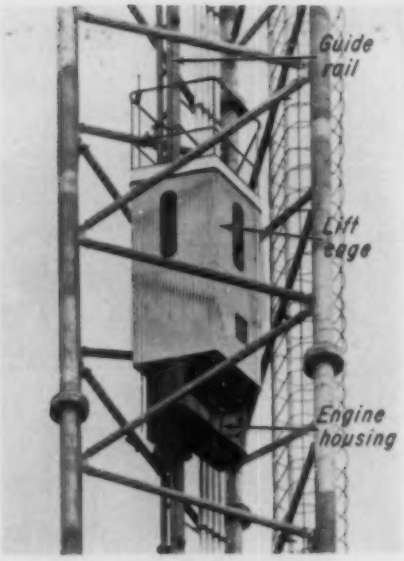


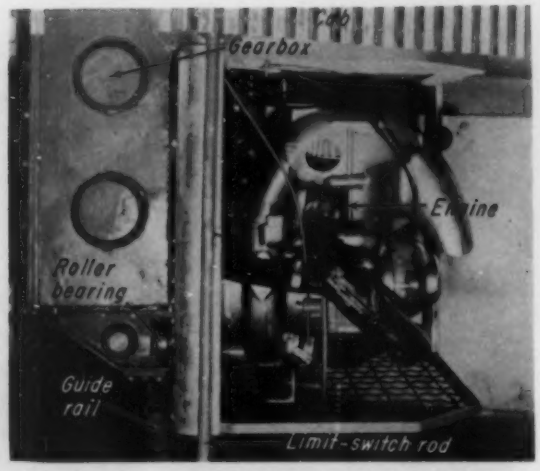
PICKUP SIGNALS are fed to the nodaling computer which vectorially adds the signals. The output, with its phase relation, represents a quantity proportional to the dynamic unbalance in preselected right and left correction planes of the rotor. The oscillator produces rotational frequency of the rotor and, through the firing circuit, ignites the strobe lamp once per revolution. Signal strength is independent of magnitude of the unbalance, which is very small when residual unbalance is reached. This eliminates the possibility of strobe-light jitters at low levels of unbalance. The filtered unbalance signal merely trips the oscillator firing circuit when the heavy spot of the rotor reaches the top. The phase shifter permits shifting the angular location at which the strobe light fires. This may be necessary when balancing enclosed rotors.

PS . . . Balancer handles rotors from 2 to 600 lb, provides for swing diameters up to 76 in. Unit locates and indicates unbalance displacements of 0.000,01 in. with a meter movement of 3⅛ in. Selector switch permits direct reading over a range of 1 to 10,000 units. Balancing speeds of 600 to 2400 rpm are provided by a 1½-hp 230-v motor. Dynamic Balancer Model SU-7, shown (at top of opposite page) balancing the rotating portion of ITT Federal Division's VORTAC air navigation antenna, is produced by Micro Balancing Inc, Garden City Park, LI, NY.

This Lift Hoists Itself

Gas-powered, self-climbing cage rises on its own guide rail. The bolt-on elevator climbs radio tower to speed construction and maintenance.

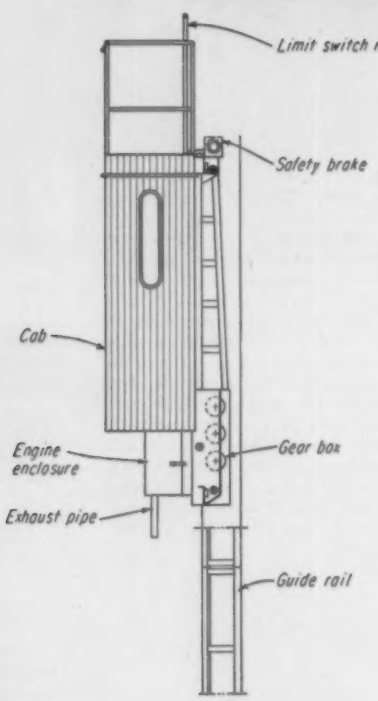


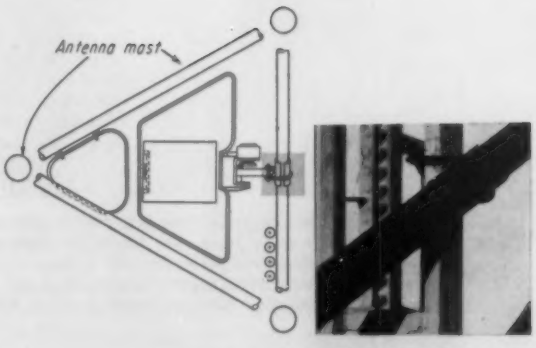


LIFT IS DRIVEN by gasoline engine through worm gears, rack and pinion. Rack is part of the guide rail along which the elevator operates. Guide rail is bolted, with U-bolts, to crossbars of triangular TV or radio mast. Ballbearing rollers at top and bottom of the cage guide the moving cage on the rail. A centrifugally operated safety brake trips when lift speed exceeds 2 ft/sec.

Elevating mechanism consists of three sets of worm gears, connected in series in one box, with a reduction of 60:1. The driving gear of each set meshes with rack pins in the guide rail. Worm shafts are connected to the motor by roller chains. Spring-loaded couplings equalize loading on all gears and prevent chain damage. The center worm is provided with a crank mechanism in the cage to permit moving the lift by hand, if necessary.

Single cylinder, reversible, 2-stroke engine is mounted beneath the cab. A trap in the cab floor provides access for simple engine adjustments such as sparkplug cleaning and carburetor tuning. A rod running through the cab and protruding above and below it acts as a limit switch to stop the cab at its limit of travel by cutting off the ignition.





PS . . . With a maximum speed of 1 ft/sec in either direction, the lift has a max payload of 1100 lb, can take 3 passengers. It is powered by a single-cylinder, gasoline engine producing 9.7 hp at 5250 rpm. Generator driven by the engine supplies the battery used for the engine starter, also an interior light, signal horn and inspection lamp. Lift is produced by Alimak-Verken AB, Skelleftea, Sweden.

PRODUCT ENGINEERING

SPECIAL REPORT

the european engineer talks...

on . . *the common market • outer market • current design • research • education • plans • agreements, cartels, trusts*

E. J. TANGERMAN, *Chief Editor*

More and more American design engineers are being sent to Europe to compare methods, seek products or ideas, locate potential affiliates, advise licensees, check licensors, find research and development groups. Others are taking European assignments for American or foreign companies. Still others find their superiors doubting their reports of what is happening in Europe, or are concerned about the effects of these happenings on their jobs here.

The American specialty of designing for quantity production is about to be challenged. Coalitions of countries like the Common Market, for "economic reasons," presage customer groups that make quantity production possible, permit cooperative design and research with adequate funding, challenge our potential sales in world markets. European companies can do research at 60 cents on our dollar, for themselves or for us. Labor costs are lower, productivity rising faster than ours. The rate of invention is higher. Postwar prosperity is opening vast new markets. And there are other such coalitions in the offing—the "Outer Market" including England, the Common Market in Latin America, Asian groups.

All these developments will affect your company and you. To evaluate the situation, PRODUCT ENGINEERING's editor has made a six-week, six-country study, including interviews with almost 100 men in about 50 organizations. Most of the men are technical directors, so their opinions and ideas, here reported in their own words, provide an authoritative cross-section. Interviews are presented country by country, first for the four largest of the Common Market group, then for two of the Outer Market group.

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COMMON MARKET HEADQUARTERS, BRUSSELS

what is the common market?...

First, what is the **Common Market? It is an economic coalition of six European countries—France, Germany, Italy, Belgium, Holland and Luxembourg**—and is properly called the European Economic Community. On the surface it is an agreement to reduce tariffs within the group, "a pool of human and natural wealth to stimulate expansion and raise the standard of living."

But any engineer who thinks about it will promptly see that **any "purely commercial" agreement that links 165 million people** (plus 53 million in dependencies) **will promptly involve engineering.** There will be standardization, agreements to exchange information and to share the cost of cooperative research and development, markets large enough for mass production on our scale, hence radical changes in design and development of specialization. There may also be cartels, agreements to reduce competition, trusts, tariff exclusions, subsidization of some industries. Engineering data may flow freely in and out—or only one way. One country might dominate, or a United States of Europe may be in the making.

Most of these questions are answered in the interviews that follow, but first we must give a little of the background of the Common Market. It began with the Marshall Plan in 1947, followed shortly by the Organization for European Economic Cooperation (OEEC, not to be confused with the European Economic Community—more familiarly, the Common Market) in 1948. The OEEC covered most of Europe, with Canada and the US sitting in.

In 1950 Robert Schumann, French foreign minister, suggested a plan for pooling coal and steel. It was signed by the six countries mentioned above the next year, has actually been working since 1953. Early in 1957, further agreements were signed at Rome, one establishing Euratom, the other the Common Market on a 15-year timetable. The United States has actively supported it, in contrast to the usual attitude of great powers, which prefers divided opposition. So much of Europe's current progress is credited to the coalition that the timetable is now being speeded up.

This group of countries is about our size in people, with a potential of 110 million workers. Capital-goods industries are expanding faster than consumer-goods industries; agriculture is declining. Except for Luxembourg, where the only industry is steel, the countries have similar broad industrial structures, but their agricultural structures differ markedly. Except for Italy, where people still spend over 40% of their incomes for food, the standards of living are similar too. **Their total industrial production, about half of ours, has increased 82% in eight years, compared with our 20%.** The big expansions are in chemicals, metal processing and basic metals, all more than doubled since 1950.

The Common Market countries are third to Latin America and Canada as US customers. Our European investments there are (in percentages of the total of $3.9 billion in Europe): 13% in West Germany, 12% in France, 6% in Italy, 5.5% in Holland, 4% in Belgium—say 40%. England, where 60% of our Old World investments are, is not a member of the group, so American

OEEC, COMMON MARKET, EFTA

	Population in Millions	
FRANCE	44.5	COMMON MARKET 165,931,000
W. GERMANY	52.2	
ITALY	48.7	
BELGIUM	9.0	
NETHERLANDS	11.2	
LUXEMBOURG	0.3	
UNITED KINGDOM	51.7	OUTER MARKET or EFTA 88,337,000
SWEDEN	7.4	
NORWAY	3.5	
DENMARK	4.5	
SWITZERLAND	5.2	
AUSTRIA	7.0	
PORTUGAL	9.0	
IRISH REPUBLIC	2.9	
GREECE	8.2	
TURKEY	26.2	
ICELAND	0.2	
SPAIN	29.7	
OEEC Total	321.4	

plants in England are in no better a position to serve Europe than plants here.

Here, in effect, is a coalition, more advanced in standard of living and industrial plant than the USSR, therefore equipped to compete with us at once in the markets of the world. It is a friendly group, to be sure, but this fact does not change its potential for competition on a scale even greater than now. Note the contrasts in the comments here reported from a Common Market official in Brussels and two European Productivity Agency officials in Paris, then go on to read the words of typical engineers, country by country, on succeeding pages. **They show the enormous engineering potential of Europe and what it can mean to you as an engineer.**

COMMON MARKET AND EFTA COMPARISONS

	COMMON MARKET	EFTA
Population, thousands	165,931	88,337
Imports from each other, 1958, billion $	4.6	3.1
" from opposite bloc " "	2.0	5.3
" from US " "	1.8	1.6
" from rest of world " "	6.7	8.9
Output (GNP), 1958, billion $	146	84

(US $442 billion, USSR $210 billion, GNP, 1958)

PIERRE PUJADE

Director, Division of Harmonization of Legislation, European Economic Community, Brussels

"Engineering collaboration is a matter of understanding between private enterprises, is not a part of present treaties, is subject to rules regarding trusts. Detailed rules are not yet laid out, but they will probably only prohibit abuses such as price fixing and market sharing. Regulations will be less severe than those of the coal and steel agreement (which permits no cartels), probably will affect only pools of 50% or more of Common Market capacity. We are currently collecting data on planned agreements, have thus far approved none; only tariff and quota schedules are set. Three of the six countries (Italy, Belgium, Luxembourg) have no anti-trust laws, so this must affect our plans. The only common policy thus far worked out is that on agriculture."

Dr ALEXANDER KING

Deputy director, European Productivity Agency, Paris

"The Common Market will accelerate technical development, forcing bigger companies and cooperative research to develop the necessary specialized equipment and processes. The small firms must have something of particular importance to contribute; the small firm in a traditional industry will be forced to the wall. This will be particularly noticeable in France, a nation with many small family companies making traditional products. Automobiles, electronics, television, and chemicals are examples of highly engineered products produced in quantities that preclude the small firm."

Dr JOACHIM HENNENHOEFER

Head, EPA Applied Research Committee, Paris

"We are adding sponsorship of fundamental research to that of applied. Projects were selected by agreement, will be handled by individuals working in their own laboratories and reporting periodically to the central group. This will enable development of standards. Planned projects do not infringe on individual company fields, will cover such subjects as fatigue failure, brittle fracture, wear of metals. We are also studying the backgrounds of scientific development: fiscal legislation, regulations, comparative expenditures by countries by years (adjusted for inflation). The Common Market will undoubtedly add to this some studies of its own because of the much more severe competitive pressures that will come."

France...

Economic expansion second only to Italy, despite an elaborate and burdensome fiscal structure and the heaviest social contributions (taxes and fringe benefits), belongs to France. The country has never been so prosperous, so energetic, so full of verve. Every Frenchman seems to be adding a room, refinishing the house, buying a small car.

New buildings of startling architecture are being built in Paris; some traditional things, like Napoleon's aqueduct, are being torn down. The ugly "little people's car"—the Citroen Deux Chevaux—proliferates faster than the scooter. **There are jobs, plenty of jobs, and money to spend.** All the traditional plaguey problems are still there—the independence of Frenchmen, the deep-seated worry over Algeria—which could, and may have to be, the breadbasket of Europe if industrialization continues. But France as a whole is driving ahead hard, showing concerted effort and applying a tremendous amount of ingenuity.

Much of this is credited to the Common Market, and Frenchman after Frenchman shocks you by admitting that the Common Market is only the first step towards something political and basic—a United States of Europe. That eventuality is remote, but it must come. National pride and tradition must yield to the harsh necessities of modern life—"everyone must sacrifice some of his individual freedom for the good of all."

France has nationalized her railroads and her power network, her coal mines and utilities, some other major plants. These plants receive financial support, although some—notably Renault and Electricité de France—turn in handsome profits. Engineers of other countries say darkly that France applied most of her redevelopment funds from the US to her government-owned plants, rather than helping all industry. There are still many little businesses in France, family-owned, and these will probably be hurt by the Common Market when protective tariffs are lowered, because of their inefficient plants and the distribution system. But France plunges relentlessly ahead into a new way of life.

M. VILLECOURT

Asst to Delegue General
a la Recherche Sci. et Tech.
French Government, Paris

"The French government is currently increasing its $180 million annual expenditure on research by 10%, adding 10 or 11 basic projects. Most government-sponsored research is basic. Industry, we estimate, spends another $200 million, of which 85% is for applied research. There are 32 industry-sponsored technical centers in France which also receive some government help, and all companies can spend 0.2% of their profits for research free of tax. Contract research is difficult in France, although some of our companies have contracts with Battelle in Frankfurt. One of our few contract research labs is the Grenoble hydraulic laboratory. Many companies, however, do their own—and even some of yours, because research here costs only 60% of your costs in the United States."

GOVERNMENT-SUPPORTED RESEARCH

The government is unusually active in support of research. The equipment and people existed before de Gaulle, but organization was poor and funds were inadequate. Now the "Délégué Général à la Recherche Scientifique et Technique," operating directly under the prime minister, has been given funds to get operations on an efficient basis, reorganize institutions, raise pay, and set up civil-service status instead of short-term contracts. **Also the administrative detail is being taken from research workers and given to administration personnel,** freeing the key men for research. These steps took two years.

Second phase is a new program for budget money and an organized spending plan. Seven different Cabinet ministers have research money and programs—totaling about $180,000,000 including basic (but not applied) research by and for the Army and the Atomic Energy Commission (CEA). The largest government organization is the Centre National de Recherche Scientifique (CNRS), which has over 100 labs with 6000 employes (half researchers) and receives $49 million a year. Some of the funds go to labs at big government universities. Another $40 million goes for basic research for the Defense Ministry and the CEA, again as much for nationalized industry (GDF), technical centers, mining. About $51 million is thus left for university labs and independent government labs, ONERA (aeronautic research) and CNET (Telecommunication).

Now the government also plans a supplementary research program, budgeted at about 10% of current spending,

split up among several "concentrated areas" of research, each administered by a committee of scientists who selected the theme. As study groups, these scientists determined areas of research in which nothing effective has been done, and where several disciplines are involved. These are broad fields, of course, and listing them shows French opinion of scientific need:

1. Economic and Social Analysis Methods
2. Applications of Genetics
3. Molecular Biology
4. Cancer and Leukemia
5. Conversion of Energy
6. Scientific Documentation
7. Exploitation of the Oceans
8. Neurophysiology and Psychopharmacology
9. Nutrition (animal and human)
10. Economic Science and Problems of Development
11. Research in Space

Third step in the program will be broader research, some of it undoubtedly on a pan-European or even worldwide basis, plus additional themes for the preceding list. Government opinion is that the Common Market has been a tremendous stimulus. It has shown that research is essential if a company is to keep up, that research pays off in broadened sales, and that cooperative research can be undertaken on an international basis, making projects possible that could not be financed by individual companies or even individual governments.

AUTOMOTIVE AND APPLIANCES

Many French companies already are working with foreign companies on research or design studies. Renault has agreements with Finmeccanica (Italy) on tractors up to 45 hp, with Alfa-Romeo for design interchange on small cars. Nord-Aviation has developmental projects with German, Italian and even English companies—some NATO, some independent. Various electronic and computer companies have international design agreements. Some of these would have happened regardless of the Common Market, but an increasing number are directly assessable to the prospects of lowered tariff protection and broader markets.

Renault agreements are particularly interesting, because it is a government-owned company. It is currently credited with having the most-automated auto plants in the world. At Billancourt, a Paris suburb, it produces 1300 engines a day, and assembles 300 of Renault's daily total of 2000 cars. Some 725 operations are performed on each engine, of which 100 are inspections; 16 transfer machines are used on the block, finished at a rate of two per minute. Each engine has a 20-min. run-in on a merry-go-round stand during which tune-up is done. Even loading of engines on trucks for transport to the Flins assembly plant is done automatically. Some 38,000 workers of the company total of 65,000 are at Billancourt, another 9000 at Flins' 1200-car-per-day plant. Business of the company last year was 260 billion old francs ($530,000,000), of which almost 4 billion ($8,150,000) was profit. The government received a billion, another billion was divided among employes as bonuses, and the rest went into an expansion reserve.

General Motors (France) does not make automobiles, (it imports them, mostly from Opel in Germany) although it does produce 11 million sparkplugs, 155,000 of France's 580,000 clothes washers, 170,000 of the 700,000 refrigerators. Only 22% of French homes have refrigerators, although 96% have electric power. Only 20.5% have washers. The French Frigidaire differs from ours in that the common size is only 4 or 5 cu ft, and plastics are used much more extensively—even in shelves. Some 30% of the unit is plastic. The washer differs markedly too. Because most French homes lack hot water, the washer must incorporate its own water heater, usually gas. Most French homes have no stoves with ovens like ours (they buy bread twice daily), **so the probable order of purchase of appliances is: stove, refrigerator, vacuum cleaner, hot-water heater, washer.** It is interesting to note that French

PETER MULLER-MUNK

American industrial designer recently lecturing under EPA auspices

"I have never seen France so vivid and alive. Everyone seems to be busy and prosperous, so houses and buildings all over France are being modernized. In industry, the reaction to my talks on industrial design has been highly favorable and interested."

A SECTION OF ENGINEERING, RENAULT

FERNAND PICARD

Chief engineer, Renault, Billancourt, also president, Societe des Ingenieurs de l'Automobile

"The French market is currently small, so the Common Market is really an expansion. It will cause concentrations and combinations to face competition, standardization, abandonment of models, particularly some of the variety in requirements demanded by local legislation. We will also be able to buy internationally, so our local suppliers will have to meet international standards to compete, not only in price but also in quality and service. Another advantage will be even greater technical interchange among engineers. I have attended meetings of your SAE, and am shortly going to an international meeting of automotive engineers at The Hague, for which I am preparing a report on current variety of specifications for automobiles required by various governments."

refrigerators are a little larger than English (3½ to 4 cu ft), and suited to more refrigeration. The 120-liter size cost an average worker 15.8 weeks of work in 1950, today costs only 6.5 weeks, so conditions are improving. But there is still a tremendous market for appliances in France.

The French aircraft industry, largely government owned, is healthy, what with such current designs as the *Caravelle* jet transport, the *Alouette* helicopter, the wire-guided anti-tank missile, and similar production items, as well as many designs still in development. It is in this industry and in electronics that the greatest amount of the fabled French ingenuity has been shown.

Currently, Nord-Aviation and a Germany company have cooperated in designing the *Transal*, a military transport. **It is neither company's ideal design, but has served to bring into the open the differences in tolerances, manufacturing practices and concepts between the two countries, so future collaboration on commercial planes will be easier. Engineering is being done in both countries, and prototype sections are being built in both,** to be compared later before production begins.

France has a favorable position in this work, because neither Germany nor Italy was allowed until recently to have the large test equipment necessary. France has fatigue, heat, atmospheric and similar test facilities of suitable size.

NATO and SHAPE ideas and needs have of course been important factors in design direction. Nord Aviation is currently designing a VTOL and an STOL plane as well as a successor to its *Gerfant* and *Griffon* turbo-ramjets, will probably cooperate with the British in these three fields. One proposed British cooperation is on a commercial, not a military, supersonic transport, for which Nord Aviation would like to use the turbo-ramjet if its current feasibility studies prove out.

Nord Aviation, which was formed by nationalizing several aircraft companies and lumping them together in a company in which the government holds 90% of the stock (some stock is owned by private parties), competes with private producers on government contracts, believes the system of recovering development costs by licensing is outmoded. The preference is for cross-licensing with equals, or cooperative development to share cost.

The Common Market possibility of purchasing outside France brought French makers into line on price, quality and delivery. (Nord Aviation now has subcontracts, however, in Belgium, Holland and Germany, is exchanging engineering data with Fiat Aviazione; finds these exchanges much freer and easier than they were.) But the real achievement is in the ability to buy steels in France as good as the Swedish ones, forgings as good as the German ones, and so on—**"Now engineers can decide on suppliers on a purely price, quality and delivery basis,"** according to Emile Stauff of the Tactical Missiles Division. He also is authority for the statement that US catalogs, bulletins, magazines, reliability data and experience or use information are excellent, "as good as or better than any other."

ELECTRONICS & COMPUTERS

Several French companies recently established manufacturing satellites ("daughter plants") in Italy, for exactly the same reason that US companies have done so in Europe—lower labor costs. There are some restrictions by the Ministries of Industry and Finance, mainly to do with loss of French work, but these ministries will actually help finance such expansion under certain circumstances. Italy offers a large potential market for electronics, so various countries are establishing plants there, but keeping design at home.

There are also cases of international exchange of engi-

PHILIPPE CHARBONNEAUX

Industrial designer, Paris, President Societe d'Esthetique Industrielle

"Currently, the greatest interest in industrial design is in the provincial cities—away from Paris—and in smaller companies which realize that they must have modern designs if they are to stay alive in Common Market competition. Larger companies and Parisian companies are more reluctant to give up their traditional ideas. Continuing efforts on the part of our society, and the obvious results of our work are, however, beginning to bear fruit."

NOEL DAUM

Technical director & v-p-engrg Nord Aviation, Chatillon-sur-Bagneux

"No country is really happy or satisfied with either the Coal & Steel Community or the Common Market. That is good; it shows there is no favoritism and provides a real working basis. Top-level negotiation and treaty will never achieve a united Europe; it must start from the bottom—from the people, who must learn to understand, to sacrifice, to work together. Our countries are too small to stand alone in this world, so we must work together and yield some nationalism to survive. Then we can finance the research and development necessary to keep up."

JACQUES DUPIN

Technical chief, Supersonic Aircraft, Nord Aviation, Chatillon-sur-Bagneux

"We are very much interested in the concept of a turbo-ramjet powered supersonic aircraft, the ramjet being used for fast climbs and the like. Expansion in air at Mach 3 is roughly three times that with a turbojet—30:1 as compared with 12:1. At high speeds, the turbojet would slow down to power only auxiliaries while the ramjet provides most of the power. The idea is suitable for short-range interception, either manned or not, and for a transport aircraft. Advantages are light weight, use of lower-temperature materials (because the turbojet is slowed down during most of the flight), excellent balance between air requirement of the two powerplants at various speeds. On our Griffon *(Mach 2.2) this design permitted simple air intakes—no moving parts—despite the varying mass airflow, but on a Mach 3 transport we'd have to vary intake to extend range."*

neering information in this field. CSF, for example, is working with Felten-Guillaume of Cologne on long-life vacuum tubes through a dually owned subsidiary, CET. In another case, research on ceramic capacitors is being interchanged. Various engineering and contract services for specialized fields are being set up—nuclear, railroad, etc.

The Common Market will also have its effects on the computer field. IBM has recently been specializing its plants in Europe, may be forced to go back to its former system of multiple-product manufacture because of tariff walls. Bull is now making its Gamma 60 computer largely from parts it produces. Where parts are bought outside, the policy is to have at least one French supplier to avoid financial and political problems. Transistors, for example, are supplied by Philips of Holland—but from a plant in Normandy. The Gamma 60 is basically international in design, requiring no special parts except alphabet or printer wheels to suit various languages. Engineering problems are not great for out-of-the-country sales, but service problems and policy problems are. These are giant machines, running $1.5 million up, so about half are leased rather than sold. A machine may commonly incorporate 35,000 transistors and 210,000 diodes. Because of newness and complexity, engineers have had to develop their own models and test equipment.

Until July of this year, the only source of building-block machine tools in France was Renault, which operates a machine-tool plant "on the side." Now, however, Ernault-Batignolles has designed a building-block automatic lathe, will provide a dozen to Renault by year-end. The industry in France is much like ours—a few big makers and many small ones. There is some likelihood that the small ones will disappear as the Common Market comes in, unless they have highly engineered specialized machines. If this occurs, it could lead to more-efficient, lower-cost production competitive with USSR. There are reports in France that the USSR has placed machine tools in Switzerland, expects to compete in Europe because of its mass-production approach to manufacture. By the same token, Russions told M. LeLan of Ernault-Batignolles that they do not expect to compete on automobiles, where Western methods are highly mechanized. Ernault-Batignolles is working out exchange agreements on engineering with Pitler in Germany, Asquith in England and Cone in the US, licensing HLMT in India, partly as a countermeasure to anticipated Russian pressure.

FRENCH INDUSTRIAL DESIGN

The home of style in many fields, France has been slow to adopt industrial design, but is moving rapidly in that direction now. The Common Market provides incentive.

Philippe Charbonneaux, head of the French industrial-design group, is currently working on an all-aluminum monorail car for speeds in the range of 500 to 1000 kph (250 to 500 mph) and distances of 500 to 1000 miles. The idea is to compete with aircraft in intercity hops in that range, similar to Ford plans for the *Levacar*.

Major competitors of French companies are expected to be Germany and Italy, both of which have for some time had industrial products of excellent appearance. Thus Bernard Laurent, director of Cie d'Esthetique Industrielle, Raymond Loewy's Paris company, is working on corporate identification for a line of welders, on cooking ranges, refrigerators, washers (for Compagnie Electro-Mecanique) a Dutch oven, the Alouette helicopter, and the like. This is a change from early work, which was largely in packaging, in department store interiors, and later in corporate-image design for British Petroleum.

One interesting case of French ingenuity reported in Paris: Societe Grenobloise d'Etudes et d'Applications Hydrauliques (SOGREAH), Grenoble, recently bought a computer to speed calculation of hydraulic problems. One of the engineers came up with the idea that there might

EMILE STAUFF

Technical chief, Tactical Missiles, Nord Aviation, Chatillon-sur-Bagneux

"Because of limited development funds, our motto has always been 'Keep it simple.' This is the secret of our success with the wire-guided antitank missile, which is simple, unsophisticated, low in cost and high in reliability. We have produced over 30,000 of them, a third for your country, and have maintained a reliability factor over 95%. One 'secret' is testing vibration and shock at all stages, utilizing a familiar technique. We test 10 of each 500 missiles under rain and vibration for a half hour. If there is one failure, we test 10 more. A failure in that group sends the entire 500 back for rework."

BERNARD LAURENT

Director, Cie d'Esthetique Industrielle, Paris

"Many young and dynamic managers are coming into French industry. They feel 'we will be overwhelmed if we do not modernize'—in plant and in ideas. This is forcing changes in designs, requiring older engineers to drop their 'old school tie' attitude about younger men and their resistance to ideas. However, the younger men are not as skilled in marketing, so there are worries about aggressive selling by Germany and Italy under Common Market rules."

PIERRE BRAILLARD

Secretary-general, Campagnie Generale de Telegraphie Sans Fil (CSF), Paris

"Reliability of electronic devices in France is being pushed by the Navy, particularly by Admiral Conge and his Comité de Coordination de Télécommunication (CCT), which has done important work on standards. Design improvements have brought electronic reliability up to those of hydraulic and pneumatic systems, so we are expanding into such fields as powerplant control, where the flexibility of electronics is desirable. Airframe and automation-equipment producers both entered the electronics business to provide their own specialized needs, but we have developed products now to meet these requirements. . . . Most standards in this field are based on intercompany ties, although NATO has also pushed for standardization."

well be an analogy between hydraulic flow and marketing of fruits. So test hydraulic analogies were set up and solved on the computer. Correlation is reported to be good.

Other examples of French ingenuity? There are the monorail where the car is rotated in the direction of the swing to stabilize it (*PE—Jan 25*) and the reaction bar cutter (*PE—Feb 22*) where the reaction of the bar to shearing clamps the cutting jaws. The Germans and English mention such accomplishments as the nuclear power station and the nuclear bombs achieved single-handedly by the French in the face of NATO and US pressures. In contrast to US opinion that France is in difficulties, and the obvious evidence—until recently—of political troubles and complications with Algeria, it begins to be obvious that France has been reborn as an industrial nation with hghiest engineering qualifications. The French credit the Common Market—but it may be just their own energy.

PHILIPPE DREYFUS

Technical director, Compagnie de Machines Bull, Paris

"The first Gamma-60 computer will go into a life-insurance company, to produce the entire policy and records—a new idea. The second goes to the state-owned public utility, Electricité de France, for engineering calculations on network distribution and on atomic research. The third goes to the French railroads (SNCF) to handle records of 400,000 pensioners and social security, possibly also the 360,000-man payroll. Two are being exported, one to the Belgian telegraph system for recording calls and billing. These are all the so-called 'expandable computer,' so they can be enlarged as work increases—a new concept."

A. LeLAN, technical director (right)
R. LeBRUSQUE, chief engineer (left)
M. BERLY, asst chief engineer

H. Ernault Batignolles, Paris

"We use electronics on our machine tools only where mechanics, hydraulics or electrical methods fail, or where power transmitted is very low. We do have electronic variable-speed drives on low powers. In the last year or two, it has become possible to buy components here in France as cheaply as outside, and our costs are now low enough to allow our competing with German makers. However, the Russians (M. LeLan had recently been to Moscow) require only 300 hr to build the lathe that takes us 600 hr, because of their quantity-production methods. Quality is lower, but that can be corrected in time. Krasni Proletarii is making 1400 engine lathes a month, Kiev will soon be making 100 to 150 multispindle and automatic lathes a month, in addition to turret lathes. This is a real threat."

Although her economists predict that the first five years of the Common Market ("Gemeinsamer Market") will bring a 100% increase in capital investment and in production, of which her share will be 35%, West Germany is a bit less than enthusiastic about the idea, judging by opinions of her engineers. Germany is itself a free market, and raising her tariffs and facing tariff walls elsewhere are not desirable prospects. Among reasons: 24% of German machinery exports went to EFTA countries last year, only 28% to other Common Market countries. The July 1 EFTA tariff cut of 20% reduced prices of small British cars $80, big ones $100 in the Swiss market, which hurts German, French and Italian makers.

Germany has, of course, been most aggressive in technology. Thus she has been the arbiter of European development, initiating and setting standards, leading in international technical cooperation. Her manufacturers' associations and engineer groups are tied together, her physical plant is mostly quite new and efficient. She has a good balance of home and export trade. Why rock the boat?

Here again, repair and maintenance and expansion are going on. Much of the extensive bomb damage of World War II has been erased. Industrial plant that was destroyed, scrapped or taken for reparations has been replaced with new that is the envy of neighbors. Coal is still the big fuel (and the dirty one in industrial communities), but oil is coming up fast. (Gas can come down from the north or up from Africa.) At the end of 1959, 32% of German households had refrigerators (4 or 5 cu ft commonest), and these are the kind that can make ice. Automobiles are common, roads are good, everybody has money, and it's a "hard" currency. And jobs are so plentiful (unemployment is under 1%) that tens of thousands of Italians are being imported on annual contracts (last year 106,000), paid good wages including benefits and fare both ways, given Italian-speaking supervision, well-housed. The Italian labor unions even have an office in the Deutsche Gewerkschaftsbund (Central labor union) office in Duesseldorf. This year, Spaniards are being added; next year's plans include Greeks.

Among engineers, English is being recognized as the international language and more and more engineers speak it—and well. A three-language (English, French, German) technical dictionary is in work. Engineers are pushing

..Germany

HANS MERSHEIMER

Chief engineer, Opel AG
Ruesselsheim

"The Common Market will not bring market sharing; if anything the competition will be tougher, both in sales and in engineering. Designs will be more refined for mass production; the small producer will be forced out. In autos, for example, eight countries buy Opels in the knocked-down condition. Take off tariffs, and they will shift to assembled cars because we can assemble here more cheaply at a rate of 1000 to 1500 a day. We design independently of General Motors, although we do have the benefit of their research. We are currently the largest GM plant, make more of our own product than any other, export more (55%) of our products. In my current 5-year forecast, I'm assuming little or no effect of the Common Market."

international cooperation, but tactfully suggest that we'll have to accept the metric system if they accept English. **And following out the metric idea, they suggest a "new degree" in radial measurement based on 100 degrees instead of the current 90 in a quarter-circle, with metric fractions instead of minutes and seconds.**

Standardization has moved apace, based on the extensive work of the VDI before World War II. But even in Germany, it has its troubles. Standards are a long way from complete; some are badly out of date. **Engineers in the know say we've gone further in standardization than they have. They'd like real international standards, but the stumbling block is always the metric vs the English system** and the resulting "noncooperative attitude" of English and American engineers.

Here are a couple of current examples: Europe, under NATO, has adopted the Lockheed *Starfighter* (F-104) but is having troubles in conversion. The VDI had to provide special conversion tables and data, just as it did for maintenance of the fighting tanks we supplied. These tanks are now phased out in the US, so no repair parts are available. Making parts in Germany to our prints was impossible, so new metric prints had to be made. Our metals have different properties, our screw threads different form and dimensions. (In the latter case, one German standards man admits they'd have done better in 1928 to take our standards instead of setting up metric ones. The English [Whitworth] and American [Sellers] threads differ only at the half-inch point—one being 12, and other 13, tpi.)

Both the Federal and the individual state budgets set aside sums for the support of basic, broadly applicable research, providing the projects have some potential governmental application. The usual procedure is for the Federal government to match a state appropriation if the project is worthy, but the Federal government never initiates support. As current examples, Dornier is being assisted on the DO-29, an STOL craft, and Bolkow on a civil plane. This support is not direct, but in the form of repayment of costs of basic development.

Usual procedure in research is for the professor or researcher to describe his proposed project. If industry, usually through an association, offers to support it, to a given amount, one or both governments may offer the rest. Up to now, industry has been the laggard.

Prof Dr MAX BARNICK

Director, Battelle Institute
Frankfurt-am-Main

"You are far ahead of us on standardization; Europe still has the inclination to originate on every design. Actually, international standards could be drawn from the specifications of various product groups, but each group tends to guard its specifications as trade secrets."

what DIN means . . .

DIN are the initials for *Deutsche Industrie Normen*—German industrial standards. They are published by the DNA—Deutsche Normenausschuss, Uhlangstrasse 175, Berlin W15, West Germany. This group is the German equivalent of the American Standards Assn, and it has a similar setup with national societies that sponsor its standards. Most standards of interest to designers are sponsored by the Verein Deutscher Ingenieure (VDI), the general association of all German engineers, more or less like our founder societies put together. Many standards are in accordance with recommendations of the International Standards Organization (ISO), Geneva, established in 1946 and with 44 industrialized countries as members. The ISO can, by means of committees and its council, recommend certain standards, but standards bodies of individual countries must declare them national standards to make them effective.

ELECTRICAL

Germany has been fortunate in that the rate of population increase and economic advance has created a market that just about matches productivity increases. Thus there is little immediate effect anticipated from the Common Market, at least in electrical products and appliances. The larger German electrical producers like AEG and Siemens were stripped of their subsidiaries as a result of the war, as well as of their close connection with American companies. There is some sharing of research data again, but relatively little on design information, so the industry has tended to turn inward. Exports currently are 25% or less, and German standards are stricter than international ones, so export units differ only in outlet, cyclage or voltage. There may be greater changes than have been anticipated, but design engineers are not yet concerned. They expect, if anything, more technical agreements and more information interchange, but quite frankly assume that the flow will be out of Germany, not in. Two ex-

Dr JUSTUS FUERSTENAU (left), Foreign Trade Dept
Dr HEINZ WEIGELD, economist for machine tools
HANS GEORG STAECKER, Foreign Trade Dept (right)

Verein Deutscher Maschinenbau-Anstalten (VDMA)
Frankfurt-am-Main

"There are about 500 machine-tool builders in Germany, and about 50% of our production is for export. About half of that is to America. We can produce standard machines for about half your prices, even with our increased material costs and higher labor investment because of less automation. Most of our builders are small, so we have begun combined research, some on cutting at Aachen under Prof Opitz, some on vibration at Munich, some on ceramic tools at Darmstadt. The Munich studies showed that most of our vibration problems are caused by motors, so we have had the motors redesigned to end this source of trouble. These are now standard and interchangeable. We believe quality and uniqueness in engineering design will be more important to us than Common Market Aids."

Dr Engr ERICH SCHLOBACH

VDMA, Dusseldorf
also VDI Standards Committee

"Our committees have always been Pan-European, often had American and/or English members as well. We try to cover the industrial world. That's why so many of the DIN have been broadly accepted. We also make pertinent abstracts of engineering literature of the world at the rate of 30,000 a year, provide design data sheets, special memos and other services. Our DIN machine-tool standards are the most advanced and complete, because the rate of change in this industry has been relatively slow. VDI maintains a list of actual and potential research projects financed by industry with government support, as well as providing other data."

FRITZ P. KAERGER

Chief engineer, Maschinenfabrik
Reifenhauser, Troisdorf

"Plastics-machinery makers in Germany are small family-owned companies. We can thus make gentlemen's agreements to avoid direct competition and employe-pirating. We also act as agents for each other on a commission basis. We have been so busy that there hasn't been time or impetus for cooperative research, and we're too small individually to finance much. The Common Market may change all this, creating international combines with funds and markets enough to justify cooperative work. We, incidentally, have standardized extruder screws internationally, even in the US, to 30, 45, 60, 90, 120, 150 and 200 mm."

amples are the use of epoxy resins for insulation (AEG)—first applied practically in Switzerland—and the extensive use of permanent magnets (Krupp).

The Federal research budget is small, those of the States very large, but the latter include funds for the support of *hochschulen* and universities as well. North-Rhine Westphalia, for example, has a 30-million Deutschmark ($7,000,000 approx) budget for the Aachen Technische Hochschule (Aachen Technical University). One difficulty in Western Germany is that there is no cabinet representation at Bonn for either education or research, although all universities and *hochschulen* are government-operated. The Committee on Scientific Affairs has, however, been obtaining increased support, and two organizations, the Forschungsgemeinschaft (Research Assn) and the Stifterverband, have been allocated funds for research support. These totaled 106 million marks in 1959 (about $25,500,000).

MACHINE TOOLS

There are about 500 German machine-tool manufacturers, of which only 20 or 25 big ones are really interested in export, although 50% of production is exported ($200 million of $434 million last year). German machine-tool imports are relatively low ($35.8 million last year), roughly half American, half Swiss, and mostly special machines not made in Germany. As a rough figure, German engineers say American tools are worth 2 or 2.5 marks to the dollar in Germany—about half their exchange value—in terms of German costs to duplicate them.

The technical standard on acceptance testing for machine tools, set up by Georg Schlesinger back in 1936, is still the standard in Germany and France, with slight modifications. It is the heart of a fairly extensive system of standards, somewhat more advanced than those in other fields. This is because technical advance has been slow in machine tools. Germany has not pushed automation thus far, particularly of the transfer-machine type, but labor shortages are forcing changes in this area. Application of electronics has been somewhat slow as well.

Several of the smaller builders of machinery other than machine tools hope that the Common Market will result in international cooperation on research. Small companies suffer competitively from the lack of research unless an association combines to support it. The lack is mitigated on occasion by international licensing agreements. Reifenhäuser, for example, makes extruder screws for plastic machines of other companies, has bottle blowers from IWK (another German company), and is licensed by an Argentine company for de-ionizers. After an abortive attempt to produce electronic components, Reifenhäuser first bought them and made "black box" assemblies, but now buys the whole business because of the shortage of skilled labor—this despite the fact that its 600 employes include 35 electrical engineers.

Support for the attitude of Frank Griffiths of Austin (England) that subordinate parts of plastics-extrusion machinery cost too much came from an estimate by Fritz Kärger, chief engineer of Reifenhäuser, that the conventional machine has 4/5 (rather than ¾) of its cost in the opening and closing mechanism. On the other hand, one new German design shows ¾ of cost in the extruder, ¼ in the die mechanism, a more logical proportion.

Among small companies, competitive problems are often avoided by straightforward "gentlemen's agreements" to stay out of each other's precise fields or market areas. This avoids cutthroat competition, but does have the effect of slowing development, particularly because business has been so good in the past 15 years. There are new machine types, however, especially in the newer fields like plastics. Reifenhäuser, for example, has plastics extruders made on the "baukasten" or building-block principle, and two new machines, a corrugated-plastic sheet extruder producing sheet 4 to 5 mm thick in continuous rolls, and the first twin bag blower.

There is incidentally, some pressure in Germany to change the system of engineering education to obtain graduates with a broader background. An example would link courses in machine building and electrical engineering, for increasing emphasis on electrical and electronic circuits. The effort is to combine the theoretical training in a science with the practical training, thus to reduce current difficulties in communication between university graduates and institute technicians or shopmen. In Germany, this distinction is so strong that it is almost social.

AUTOMOTIVE

German opinion is that the Common Market will result in refinement of automotive design and a tougher competitive battle. The big assembly plant can become even bigger, allowing redesign for mass assembly rather than for knocked-down shipment to satellite assembly plants in various countries. Opel, for example, has an 80-car-a-day assembly plant in Biel (Bienne), Switzerland, which could be more efficiently used in producing parts if all assembly were done in the main plant.

There is also no evidence of market splitting in automobiles—gentlemen's agreements to stay out of areas or size ranges or types—as exists in machinery. This also means that the competition will be stepped up, forcing out the small and inefficient producer in most cases. As in most European countries, a particular auto maker must design and produce most of his own parts. Design can't be patterned after ours however, because of the European emphasis on the small car. When roads are narrow and gasoline approaches a dollar a gallon, a large car is merely an affectation. But this does call for real ingenuity in design (as our makers are discovering). The small car has just as many parts, and requires just as many machining operations, so cost can be pared out only in material (which in Europe *is* more costly) and in weight (which takes more power to haul around). Europe seems also to have known all along that the annual model represents a tooling cost too high to amortize.

Hans Mersheimer, chief engineer of Opel at Ruesselsheim, who was stylist until the middle of last year, is an engineer and production man as well. Says he: "The car for France can be considerably different from that for Germany. The Frenchman doesn't care about the appearance of his car as long as it takes him where he wants to go. The German, on the other hand, loves his car, so he insists upon a quality look as well as quality engineering in every detail."

KRUPP

Friedrich Krupp at Essen, Germany's largest company in terms of sales, manufactures a wider variety of products than any American company, has been the subject of Allied efforts to break up, but goes on stronger than ever. It is, in fact, the subject of a special law at Bonn which bypasses normal inheritance laws. Krupp is solely owned now by Alfried von Bohlen, will go by primogeniture solely to his eldest son, regardless of the number of normal heirs. So it was of considerable interest to me to talk to Krupp engineers. Some of their ideas:

"**The Common Market is essentially political,** so we cannot arrive at agreement with EFTA members. We feel that 13 is a much more practical union than Six and

Dr Engr ROBERT LOTZ

Director of Development
Friedrich Krupp, Essen

"We are already reaching international standards in railway equipment and heating apparatus. Next will be automobiles, relatively easy because your influence has been so strong that most standards are near yours. Local authorities will delay it, but they cannot stop it. Standards among manufacturers will be reached by agreement in much less time. Boundary lines in geography and in thinking are being erased rapidly; the young people all wear the blue jeans and oversize sweaters, the girls with Bardot haircuts, the boys with Presley sideburns. What is nationalism to them?"

Dr Engr O. E. RUEDIGER

Director, Essen Research Center
Friedrich Krupp AG

"Germany has had DIN standards on hard metals for a long time. These are now being converted to international standards under the ISO. . . . Our research indicates that cermets have little future; they're too difficult to handle, too brittle at room temperature. The superalloys have the future at most temperatures, with moly, tungsten and niobium taking over at higher temperatures."

Dr Engr HELMUT ELENZ

Chief, Machine-tool Production
Schiess AG, Duesseldorf

"Even though we Germans are basically standards-minded, some big companies and some designers kick over the traces and set their own. Also, some designs require special treatments. We found, for example, that we had to select standards for spline shafts from the center of the available DIN group, and for big bearings we had to set our own standards closer than those of DIN for big boring mills. We are already using the standard series of machine-tool motors introduced at Hannover. These are fully interchangeable. Two general observations: (1) We are designing standard engine lathes set on end so they take less space and one man can handle as many as five. (2) We tend to prefer single automatic machines rather than transfer machines; they're cheaper and more flexible."

GERMANY'S INDUSTRIAL-DESIGN ORGANIZATION is called "Industrie - Gestaltung." It has a permanent exhibit of well-designed products at the "Little House," which is part of the Krupp homestead, Villa Huegel, in Essen. Here are Dr Mahlberg, director of the exhibit (left), and Dr Heudinger, chairman of the board of Villa Huegel, who sponsored my tour of the exhibit.

Engr ALFRIED KRUPP von BOHLEN und HALBACH
Sole proprietor, Friedrich Krupp, Essen

Now 53, Alfried von Bohlen received his diploma-engineer in 1936, after studying in Munich, Berlin and Aachen. He took over Krupp's in 1943, just in time to be imprisoned in 1945 as a war criminal. Granted amnesty in 1951, he has rebuilt Krupp, although a third of its plant was destroyed in the war and other portions were torn down for reparations and scrap indemnity. He is probably the world's richest engineer. As the son of a Krupp daughter, his family name is not Krupp but von Bohlen und Halbach.

Dr BERNHARDT KALKNER
General manager, Engineering
AEG, Frankfurt-am-Main

"Our exports are only 25% of production, so we do not assume the Common Market will affect us seriously. DIN standards are a little tighter on electrical products than international ones, so we can fill export requirements easily. We do have occasional problems, however. For example, a locomotive to cross the French border had to be 60⅔ cycles for Germany and 50 cycles for France. Again, we must make refrigerators to three standards, one for northern Europe, one for central Europe and one for the Mediterranean area. Norway requires a differential temperature of only 21C; Italy, 41C."

Engr GUENTHER VOELKER
Head, Service Engineering
Schiess AG, Duesseldorf

"Schiess is essentially a tailor of machine tools, building 60% for export. We are currently building a special planer-type miller with 21-meter table and 145 motors to go to Sulzer in Switzerland for diesels, a 10-meter boring mill with twin tables for Red China, vertical lathes for India, Poland and half a dozen other countries. Each requires some design adjustment to meet local regulations. We also exchange information with some other companies—like Berthiez in France. Most of this is research data rather than design detail."

Seven, but EFTA countries will not yield political independence, as Germany had to, to join the Common Market. Actually, we in Germany are nearest to achievement of the Common Market objectives—we had neither tariffs nor quotas. So we will have to make concessions and sacrifices for a time, and these will not be appreciated by other countries.

"It seems that all countries suddenly want to go into mass production, and without altering present designs. The inevitable result will be chaos until each country comes to the sober realization that it has certain basic designs and certain basic products it can make, and some marginal ones that it cannot. **Inter-country competition can be as foolish as that between companies.**"

And again: "Standards can be considered in two groups: (1) those for the customer, and (2) those for the manufacturer. Group 1 is the more important, should be achieved first, but offers the most complications. In the Common Market, this kind of standardization is gaining momentum, but will take longer to achieve than the Market itself. Little local authorities will delay it, as they always have. Class 2 standards could be achieved in a year—they simply require agreements between makers. And agreement between makers within a country is only a short step from international agreement, at least within the metric countries. But agreement between people at the cultural level is moving so fast that it will force us engineers—and even finally the diplomats—to agree."

what's what on standards . . .

Netherlands Standards Organization is heading study for unification of electrical standards in Common Market countries. Each of the six has set up a technical secretariat within its standards body to check deviations from IEC recommendations and propose changes where advisable, either in recommendation or in national standard. Germany is concentrating on high-voltage switchgear and motor-operated appliances; France on motors, generators, power transformers, contactors and low-V switchgear; Italy on earth-leakable and miniature circuitbreakers; Belgium on switches (domestic), plugs, sockets and small transformers; Holland on cables, cords, and incandescent lamps. Similar work on mechanical-engineering standards is being headed by Association Francaise de Normalization.

EFTA countries, apprehensive of Common Market pressure on standards, called a meeting of ISO and IEC committees of all 13 countries in June. EFTA countries agreed to accept all ISO and IEC recommendations, even at the cost of sacrificing established national practice, to avoid competitive disadvantage created by the political nature of the Common Market grouping, which makes speedy combined action possible. The Common Market groups will meet again in October in Milan, with Outer Seven observers sitting in. Prospects are for a major push on common standards.

Belgium . . .

Belgium typifies the small countries that form half the membership of the Common Market. Like Holland and Luxemburg, it must make its way by being fast on its economic feet, by snatching the morsels between table and floor. Thus its business people are flexible and ingenious, quick to make and implement decisions.

Consider the burgomaster of Malines (Mechelen), M. Antoine Spinoy. He anticipated the problem of American and British companies who would have to provide themselves with plants inside the Common Market area. What could be better, he reasoned, than a relatively small town midway between Brussels and Antwerp, with good rail and road connections? What's more, Common Market headquarters are nearby. So he asked his commune to buy up all surrounding land and subdivide it into industrial sites. Then he went out to find new industries. From the United States, he got Procter & Gamble, the Paint & Varnish Division of DuPont, Burndy Engineering, McCulloch Motors. From England he got Standard-Triumph. Before his larger rivals in Brussels, Antwerp, Ghent and Bruges, intent on their own competition, realized what was happening, he had beaten them to five out-Market plums.

Or consider the case of CIVA (Construction & Importation Vehicles Automobile) in Antwerp, a 400-man automotive assembly plant. Here were assembled the Standard-Triumph (England), Borgward (Germany) and Skoda (Czech) cars at a rate of 25 to 30 cars a day. Each incorporated a certain minimum percentage of Belgian-made parts. But Standard-Triumph has been wooed away to Malines. Borgward will have no reason to assemble in Belgium as the Common Market knocks down internal tariff walls. So CIVA has recently contracted to assemble 2000 *Moskvich* cars (USSR) which will incorporate no Belgian parts. This is assuredly the forerunner of much more to come. First supplies of Russian Volga cars have already arrived, and the question of assembly is being considered both by CIVA and Soviet authorities. The latter, it seems, are thinking of using CIVA as the spearhead of their attack on Western markets, which may ultimately include the US. They chose CIVA only after long palavers in which they tried to tie the assembly contract in with stocking and sale of Russian petroleum products. The poor state of the present oil market stopped this drive.

These are, of course, economic, not engineering examples. So consider Bell Telephone Mfg. Co, Antwerp plant of International Telephone & Telegraph. It employs 10,000 people, is one of five European plants of I T & T. The others are in England (Std Telephone & Cables—30,000), W Germany (Std Electrik Lorenz—24,000), France (Le Materiale Telephonique—5000) and Switzerland (Std Telephon & Radio—1500). The company is developing data-processing, sorting and material-handling systems, including one for the US Post Office recently described in PE. The latter was developed at Antwerp, which specializes in letter sorters and banking equipment. The German plant specializes in airline seat-reservation systems and mail-order handling by tape. English and French plants have other specialties. It has been customary to distribute work among the five plants according to their particular skills. Engineers are moved from plant to plant regardless of their nationalities as need and skill dictate. Skilled specialists command a premium all over Europe, especially in these new techniques, so engineering and research teams are built up in the plants that do not duplicate each other.

Yet opportunities presented by the particular country are not lost. Belgium, for example, will refund half the cost of basic research sponsored at a university by a Belgian company, providing the program, as proposed jointly by a professor and a company, is approved in advance. Thus government subsidizes industrial development. Bell Telephone has several such programs, the major one being a study of intermetallic compounds to replace germanium and silicon in semiconductors. The work is being done at the ancient University of Ghent.

Engineers at Bell Telephone, says B. Wielemans, automation project manager, are convinced that the ultimate letter- and check-sorting equipment will be optical rather than magnetic, and are working in that direction. Their current sorter uses a magnetic tape put on a jacket which carries the document. One of this type is presently being designed for First National City Bank in New York. They feel the jacket protects the document and the multiple-entry tape system prevents errors made by the current system approved by the American Bankers Assn, which utilizes magnetic-ink numerals on the check itself.

Another interesting case: Société Belge d'Electrochimie has its plant on a canal from Ghent seaport into Dutch territory, has made calcium-cyanamide fertilizers since 1928. Raising Ghent's capacity from 10,000- to 50,000-ton vessels meant enlargement of the canal, offered good, cheap shipping. But the fertilizer process wasted 10% in final nitrating. So chief Chemical Engineer Gustave Soetaert experimented. He increased pressure in the processing vessel—and cut the loss to 2%, at the same time increasing output six-fold and cutting initial heat three-quarters. So, just as the canal becomes available, Electrochimie will complete a new plant to serve the Common Market at minimum cost.

Belgium, limited in size, funds and natural resources, and facing loss of her colonial possessions (the Congo, her largest, was freed June 30), is likely to develop engineering primarily in the electronic and automation area.

Italy . . .

Italy suggests many parallels with the United States of several decades ago. There is an agrarian south and an industrial north, an excess of relatively unskilled labor, a shortage of engineers, some paternalism and much poverty, a rapidly developing economy. But automation is moving more slowly here than in other large countries because of social and economic pressures. Italy is growing as a site for satellite (or "daughter") plants, as a source of German and Swiss immigrant labor.

Yet, as in the Renaissance, Italy is the source of much industrial design, particularly in automobile bodies and office machinery, loosely included in what clothes designers call "the Italian look." Her engineers believe that Italy's ability at styling, her productive capacity, and her willingness to learn can be major contributions to the Common Market (Mercato Commune). Italians have designed and produced for export for years, can work to standards, have kept close contact with engineering development, are enthusiastic and ambitious. Indications are that engineering, particularly with respect to standards, has been strongly influenced by German practice, but that more and more French and American influences are having their effect.

Here, as elsewhere in western Europe, the needs of NATO have had powerful effects on standards and approaches, but in Italy more so on engineering design thinking. The engineers are very much impressed with recent American developments, keep abreast by following American technical literature and by regular inspection trips to the United States. **Several Italian engineers told me that American technical literature is the finest and most complete in the world, and that it is easier to get information from American companies than from European ones.** Many Italian engineers have a reading knowledge of English and German, and major companies have libraries which make regular digests of current literature.

Even so, there are many complications. Textbooks and handbooks in Italian are uncommon, so German and American books are quite commonly used. Big companies like Fiat, Innocenti and Olivetti produce their own standards and data sheets, as big American companies do, and these are distributed to smaller companies on a limited basis; Fiat, for example, tends to set automotive standards because it represents about 90% of Italian automobile production.

However, many military aircraft and automotive developments are based on American ones, and here the conversion from English to metric makes trouble. The American asymmetrical-beam headlight has been adopted and gradually standardized by a number of countries (Italy, Holland, Germany) with modifications to suit European conditions, and is now called in Italy the "European headlight." On the other hand, the American hydraulic brake system was taken over under license without modification, dimensions simply being converted to metric for interchangeability. Resulting metric dimensions are fractional, hence more difficult to maintain.

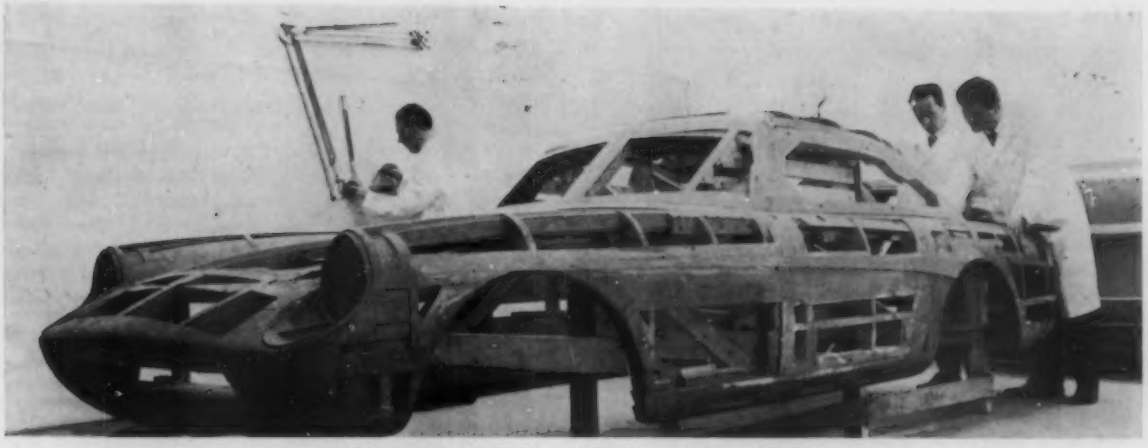
Other complications are created by the difficulties in finding European equivalents for American materials or services. There is, however, a contrasting advantage. Italian producers of parts and materials are not as heavily mechanized as American ones, so they will eagerly under-

Dr G. P. CASIRAGHI
Technical Director, Piaggio & Cia, Genoa

"Nationalism is disappearing in Western Europe for two reasons. First, engineers and scientists are international-minded because their professions recognize no geographical limitations. Second, and more important, children are traveling and going to school independently of boundaries. This is good for Italy, because it helps to ease our labor surplus. The Common Market helps in this, as well as giving us faster and more thorough technical interchange. And interchange is vital to us because of our shortage of skilled engineers on the one hand and our need for industrialization on the other. We are doing everything we can to improve both situations, but we need outside help as well."

GIUSEPPE PERO
Presidente, Associazione Nazionale
Costruttori Machine per Ufficio, Milan
(Natl Assn of Office-machine Constructors)

"The Common Market will be an advantage to office-machine makers because our designs have anticipated such interchange. The increased intertrade will improve our markets, particularly in countries not making machines enough for their own use. Italy and Germany currently export 35 to 40% of their office-machine production. Our own figures are 50% on calculating machines, 35% on typewriters. France's production is only sufficient for current domestic demand. Other countries, within and without the Common Market, are rapidly industrializing, which promptly creates demand for office machinery. The calculators are particularly helpful in design problems."



FARINA DESIGNERS MOCK UP A NEW FORM

take a development program for a special material or component. This can also be done at far more reasonable cost than here because of the greater flexibility in small-volume production. Piaggio, for example, is the Italian licensee on the Lycoming engine, which is made to American standards. The steel forging alloy specified for the crankshaft was not available, but Piaggio gave the composition to a local steel company, which developed a satisfactory equivalent for the job.

There is evidence that Italy has adopted many of the DIN standards (Deutsche Industrie Normen). Regular meetings were held in the late Thirties to develop standards among what are now the Common Market countries, under chairmanship of Max Thoennissen, now honorary president of the VDI. This effort was continued through the early years of the war, and is still going on. Through the efforts of the International Standards Organization, Geneva, there has also been some standardization in tolerances, in measurement, and in metric-size bolts.

Efforts to create international standards have been hampered by government (at all levels), rather than helped. For example, all sorts of local and national regulations have been set up by governments for motor cars, so that each area requires almost a different model. **Engineers can readily arrive at agreement on some such element as headlight position, color, intensity and so on, but governments then confuse and complicate the problem. The Common Market is reducing these difficulties,** even if it only encourages one country to accept the standard automobiles of another "as is."

No discussion of standardization would be complete without mentioning the influence of NATO. Meetings of NATO members have been held to arrive at standards for military vehicles and other devices, and a good measure of these have passed over into use for civilian counterparts.

Italy gives little or no governmental support to research. There is a national research council, but funds are so short, most companies are forced to do their own, or to finance it at a university.

All universities, incidentally, are government-operated except one. They suffer from a chronic shortage of funds and teachers, so here industry has come to the rescue again, each major industry contributing to the support of the university in its city. Thus Dr G. P. Casiraghi, technical director of Piaggio & Cia, Genoa, and one of Italy's top aircraft designers, is also a professor at the University of

Prof Dr VITTORIO VALLETTA
Managing director, Fiat

"It is essential that we maintain work for all Fiat people. Automation and agreements for foreign manufacture must allow for this. We also feel that the workers' well-being is our responsibility, not only in our plants but in their homes. We have implemented this belief with a strong training program, vacation and medical facilities for families, apartments and other provisions for economic improvement. We have the lowest layoff rate and the highest rate of pay in Italy, so our workers can maintain a higher standard of living."

DANTE GIACOSA
Technical Director, Fiat Automotive Div, Turin

"As the largest Italian automobile builder, we develop Italian standards and feel responsible for their maintenance. The Common Market has made us more conscious of the need for standardization on an international basis. From the manufacturer's point of view, such standardization can be very helpful economically, because it permits design for larger quantities at lower costs and promotes more rapid interchange of information. From the customer's point of view, it results in a less costly and better automobile. These are among the reasons why we have entered into a design-interchange agreement with Simca of France."

(Fiat has a GM type of organization. Giacosa once was engineering head of all Fiat divisions, but now each has its own. Giacosa is, however, head of the "Superior Technical Direction," an over-all group as its name implies. Much of his time is devoted to forward planning—a ten-year projection.)

Engr FRANCO GIVRA (left)
Engr TITO IVALDI (right)
Assts to the Technical Director, Fiat Aviation, Turin

"Our aircraft design is on the American level. We use US norms, standards, follow US MIL specs, have licenses. The exception to US practice is in hydraulics, where we use 3500 psi instead of your 3000. Except for a contract to build Caravelle parts for the French, we build only military aircraft—mostly a NATO fighter used by Italy, Germany, Greece and Turkey. It has a French-made undercarriage, some US parts, particularly in electronics."

GIOVANBATTISTA FARINA
Automotive stylist, Turin

"You ask what we mean by the Italian look. It is harmony of line and a sense of proportion, whether ornate or simple. The interrelation between the body of a beautiful woman and that of a Farina-designed car is that both have simplicity and harmony of line, so that, when they are old, one can still see how beautiful they were when they were young."

Architect CARLO ROSSELLI
Editor, Stile e Industria, Milan

"Europeans draw their inspiration from a different cultural environment than Americans, so it is harder for us to appreciate your designs. Most European industrial design is done by men trained as architects . . . We are planning a design school, but do not yet have one—although there are now some industrial-design courses for architects. The Common Market will probably speed amalgamation of European culture. There are already examples of supranationalism, and various peoples begin to appreciate what others design. There may well be a new Pan-European culture as a result, and there will certainly be a tremendous impetus to design."

Dr Engr MASSIMO SCORTECCI
Technical director, Mechanical Div, Innocenti, Milan

"German standards are more advanced than ours, so we try to base ours on theirs. Our principal advantage is that we can manufacture at 20% under your costs—that's why we have so many American licenses and agreements. We also began in June the manufacture of the British Austin-Morris."

Genoa for a third of his time. Piaggio gives him leave to teach aircraft engineering, for which he receives the equivalent of $50 per month. In this university, of 38 professors in engineering, only five are full-time men; 28 or 29 are employed in industry as is Professor Casiraghi.

Similarly, Fiat assists the Polytechnic of Turin. Engineer Giacosa, technical director of the Fiat Automotive Division, teaches automobile design and construction; Engineer Gabrielli, technical director of the Fiat Aircraft Division, teaches aircraft design and construction; Engineer Bono of Fiat R & D heads the Galileo Ferrari Research Institute on Electronics. (In Italy, as in Germany, the title "Professor" has precedence over "Doctor.")

There is also very wide use of consultants in Italy, more so than in other countries—another indication of the technical shortage. Many college professors are also consultants for industry, so their specialized knowledge can be spread as widely as possible and their incomes brought up to a reasonable amount. Also, many specialist engineers, naval architects and other designers must be consultants because many plants are too small to use them full time. Another indication is the way in which large families pool their resources to get one son through engineering college. He will have social status and income as a result and will repay the whole family for their sacrifices. This is particularly true of south-Italian and Sicilian families. The major shortage is at the "designer" level—the equivalent of our project engineer.

Italian engineers feel the Common Market will help their country a great deal. **They feel that engineering itself is broader than even the Common Market, so engineers must think broadly too.** They feel that the remnants of nationalism that remain will disappear more and more rapidly as time goes on, particularly as the next generation grows up. The present-day youth are traveling and going to school all over Europe, irrespective of national barriers, and they reach a rapport with their "foreign" fellows that their fathers never could because of travel limitations.

Company or trade secrecy is rapidly easing in Italy. But here American influence has been a deterrent rather than a help in some instances. **We introduced in Italy such concepts as classified documents, closed specifications and bids, management training and the like which actually retarded the dropping of intercompany barriers.**

INTERCHANGE AGREEMENTS

One effect of the impending Common Market has been an increase in international interchange of engineering and manufacturing knowledge. Under NATO auspices, Fiat builds a fighter plane with a British engine and a French undercarriage. With the Common Market in mind, Alfa-Romeo (Italy) and Renault (France) have entered into an agreement whereby Renault will build the *Julietta* (except for the engine) in France and Alfa-Romeo will assemble the *Dauphine* in Italy, making some parts eventually. This is particularly interesting because both companies are government-owned—so it is a treaty rather than a commercial agreement. (Innocenti, Lancia and one of Italy's largest oil refineries are, incidentally, among companies partially owned by the Vatican, according to Italian engineers.) Even more startling is the agreement between Simca (France) and Fiat whereby some parts of their cars are standardized for interchangeability. Fiat also

Architect ETTORE SOTTSASS, jr
Industrial designer
Olivetti, Milan

"There is more design distinction in typewriters than there was 20 years ago. The Italian machine differs markedly both in design and in engineering from its German and Swiss counterparts. Italian machines are very light and 'intellectual' in concept; the German and Swiss are simpler in engineering, heavier in appearance. The American design is like that of Germany, but has a 'mass-production look.'"

builds parts for the Caravelle jet aircraft made by Sud-Aviation of France, Innocenti has started to make the Austin-Morris (British Motors), expects to be making all parts within a year—a typical case of licensing by an Outer Market company to maintain a foothold.

Italian engineers can go outside Italy for parts and components if price, delivery or competence is favorable and Italian labor is not seriously affected. The excess of labor results in strong pressures to avoid such practices, however, unless the advantage is really great. The ultimate effect is that local prices and deliveries are kept favorable, so foreign imports are largely specialties such as drop forgings from Germany or electronics from Holland.

THE "ITALIAN LOOK" IN DESIGN

All Europe has been extremely conscious of the "Italian look," not only in hair-dos and clothing but also in industrial products—typewriters, sewing machines, calculators, automobiles. An earlier wave of design—the Renaissance—began there as well, featuring florid design. The new design emphasizes lightness, airiness, simplicity.

Carlo Rosselli, editor of *Stile é Industria*, one of the world's leading industrial-design magazines, typifies the Italian industrial designer. He is an architect, in fact spends half his working hours in his father-in-law's architectural office. So is the industrial designer at Olivetti, Ettore Sottsass. But Giovanbattista Farina, the top auto stylist, is a carpenter who began styling automobile bodies when they were of wood.

In Italy, there is yet no school of industrial design. Architects can take some optional courses in the subject but there are no Italian—or, in fact, European—equivalents of our American schools. Nor are there nearly as many industrial designers. Products have good appearance design, often by coincidence; one large Italian department store has hired its own industrial designer to assist its many small suppliers in providing products with broader appeal and marketability.

Sottsass, at Olivetti, has undertaken an interesting experiment. He is collaborating with the Hochschule fur Gestaltung at Ulm-am-Donau, near Munich, Germany (a continuation of the Bauhaus), in human-engineering studies for Olivetti—probably the first instance of Italo-German cooperation in this field. The school is also working in symbology for Olivetti, carrying further the German-initiated graphic symbols for machine controls. Italian and French makers are now also using this system to avoid language difficulties on machine control and instrument panels.

Sottsass points out that each European country is searching for new design ideas, new colors and forms by going to other countries. Germans and French are coming to Italy for ideas, yet Sottsass himself has a Dutch and a German assistant as sources of outside ideas. Both have excellent technical backgrounds, but the Dutchman tends to be humorous, light and broad, the German solid, heavy, serious and traditional in the "arbeits hypothesis." Sottsass feels that German emphasis on style in construction and building equipment is exceptional, that German appearance design is in general weak. German strength lies in science and engineering theory, the ability to "start on a broad basis and become specific," as he puts it.

Both Sottsass and Rosselli mention this "mass-production look" of American products, and feel that it comes from a different cultural background as well as a different economic and production background. Europe looks at mass production as a danger, according to Sottsass, so even mass-produced equipment must not look like it. Rosselli feels that the differences in American and European cultural environments are the reason why Europeans find it hard to appreciate American design. Sottsass points out that even in refrigerators there is a tendency to individualistic design in Europe.

Will the Common Market tend to level design differences or accentuate them? Sottsass believes it may accentuate them. Rosselli, however, sees a pan-European culture arising, can already find some examples of supranationalism. He feels the national cultures will amalgamate, and that people in one European country are beginning to appreciate what other countries make.

Sottsass emphasizes that a major distinction between American and European design approaches is that the European must do things with limited means—with ingenuity replacing money and equipment. He illustrates: "Ingenuity is typified by the mountaineer who, with a stick, an axe, three nails and a piece of rope, can build a cabin for 20 people."

Giovanbattista Farina was the youngest of 10 children born to a carpenter. His first car styling was done when his father was asked to build wooden bodies for Lancia.

He feels the strongest influences on American industrial design are currently General Motors and Ford, who have, in effect, built a style given to the customer rather than being drawn from him.

It is his belief that the current emphasis on the "Italian look" has arisen from the fact that everyone tries to borrow or adapt a design he likes. For example, Farina lowered the radiator to achieve road-edge visibility with the fender as a gage. Other designers have attempted to achieve the same desirable result in other ways. The essential, in his opinion, is to have a sense of proportion.

Surprisingly, Farina has a new $5,000,000 plant in Turin, which puts bodies on 50 cars a day. Seven models are produced on lines, including one Cadillac a day, for export to the US.

His final words: "Fins started out as vertical, went horizontal, may fold in next. These are stylings to stimulate the market. Our problem is simpler—we have all the work we can do for two years ahead, hence we can design as if we were building planes—simpler lines, functional beauty."

the european free trade association . . .

Call it EFTA, Outer Market, Outer Seven, or any of the other popular names—the group of Great Britain, Switzerland, Austria, Portugal, Sweden, Norway and Denmark is a loose affiliation, quite different from the Common Market group. It was set up last year as a trade security device—as a threat to the Common Market—with no members yielding their own independence and with no plans to form a full economic union, let alone a political federation.

The Common Market cut tariffs inside by 10% in January, '59, will cut 20% more in the next four months, will ultimately have a common outside tariff. The EFTA cut tariffs 20% July 1, plans further cuts, but nations will maintain their own tariffs toward outsiders. England represents 59% of the total EFTA population, 63% of the gross national product, 75% of the industrial production—one big and six little members, compared with the Common Market's more-balanced three and three.

Further, the Seven tend to compete (particularly Great Britain, Sweden and Switzerland), are scattered geographically and ideologically. The three Scandinavian countries form a bloc of their own, Switzerland stands aloof, England eyes the Common Market longingly. The six smaller countries of EFTA are not as highly industrialized as Great Britain, so represent a great potential market for British goods, but Common Market countries have been much better customers—highly industrialized countries always are.

Basically, what's happening is that large areas of the world are undergoing industrial revolution. It is very fast, sometimes ruthless. Countries that were good customers for industrial products only a few years ago now make them for themselves. Some have already begun to compete for export business. However, industrialization of a country usually makes it a better customer for engineered products—aircraft, electronics, machinery—even technical assistance and consulting services. These are, for example, the exports Great Britain has been pushing with some success to countries which are now, almost suddenly, in a rival bloc.

EFTA countries have imported about a third of their total from the rival bloc, which buys only a fifth from EFTA. British sales to other EFTA members last year were just under $1 billion, to Common Market countries $1.3 billion. So Britain is concerned, and many British businessmen predict (or hope) that EFTA won't last five years. Only Sweden seems to be really happy, because she expects to increase her exports to England of ballbearings, office and other machinery.

These sidelights on economics may give you some basis for evaluating the attitudes of British and Swiss engineers on succeeding pages. Any survey of European engineers would be incomplete without representation from these two countries.

English newspapers talk of a tunnel, or even a bridge, to France, less than 20 miles away at the nearest point. But to the typical British businessman, England is nearer to America than it is to Europe. He has been emphatic in his statements that Great Britain is not a part of Europe, either geographically or spiritually. The attitude that England's future was tied in with that of the Commonwealth and the United States encouraged complacency and disregard of the Common Market. But now the general opinion has changed dramatically—the Common Market is considered to be of major importance to England. England's businessmen want in, whether or not the Government knows it yet.

Some English engineers think American industrial expansion in continental Europe, plus our postwar assistance, research data in the most-active new fields, and support of the Common Market has hurt Britain's position. It is confusing when one considers that about 17% of British capital investment (400 to 500 companies) is now American, up from 14% only four years ago. Some 60% of our Old World investments are in England, which still offers the highest return of any.

So some of the more aggressive executives wear worried frowns. Much of England's industrial plant is old; so are many of her executives. There is strong feeling about this among engineers, particularly the non-school-tie, more-driving group. Says one: "One of our most damaging weaknesses is the continuing lack of, and hostility toward, formal management training. There are no Harvard Business Schools here, and none of the current management diplomas that can be picked up is worth a damn.

"Britain gets its managers in two very bad ways: Our raw recruits are nitwits from very expensive schools; they play a lot of sports (generally much worse than their opposite numbers in other countries), and have no basic talent and no enthusiasm for work. They start as executives, with no training. The other category are those to

. . England

THE DESIGN CENTRE FOR BRITISH INDUSTRIES is a permanent exhibit of well-designed British consumer goods in current production. Open daily, it is operated by the Council for Industrial Design.

SOME 10,000 WELL-DESIGNED ARTICLES are shown in photographs and samples in this Design Index maintained in London by the Council of Industrial Design.

whom the crumbs of management have fallen just prior to their retirement from the company where they've labored all their lives. Long-suffering, long-serving and rarely distinguished, these men are tired out. They are not supposed to make any impact on the company and they don't.

"Both groups are untrained. One is too lazy to absorb new ideas, the other too tired. Both are afraid to hire any new talent lest they change the shape or style of their products. Even in engineering management, the scene is stuffed with top production men who haven't the slightest design skill, talent or formal theoretical training and with bearded designers who have never struck a chisel or run a machine tool. Both walk out if someone suggests the product needs modernization, or styling.

"However, it is in publicity and selling where management's embarrassment is most acute and damaging. These are considered not quite wholesome activities. Holding the fort here are high-ranking military types, unemployed because of the ungratefulness of Colonial peoples and the decline of empire. All jolly fine chaps, highly educated, who will soon 'pick it up again, Old Boy.' Not one of them would stoop to sell." A bitter commentary, but one reflecting the point of view of the more-aggressive Briton. Great Britain was the arsenal and workshop of the world from 1850 to 1890. By 1900, however, there were four industrial nations—Great Britain, Germany, France, US. Now Sweden, Japan, Canada and the USSR must be added. India, China and Australia are coming up rapidly. England is no longer the prime supplier, just one of many countries offering its wares.

When it became evident recently that the Common Market was succeeding, even booming, and that the timetable might be advanced, Great Britain was instrumental in forming the Outer Market, principally as a countermeasure. But Commonwealth countries like Canada and Australia are building their own industries, other ones are cutting traditional ties, and good former markets are turning into licensees at best. Some are even buying elsewhere with impunity, preferring the lower prices and more modern designs of other nations to the traditional British dowdy quality. So England has made two tentative offers to join the Common Market—and has been rebuffed by the governing commission (which says "No non-full members") and the French government.

These are among the causes of the rebellious attitude of the progressives in government and industry. In politics there is "Crossbow"—based on a Conservative group from Bow—which is attacking the pressure groups that have made British foreign policy inconsistent. In industry there is the aggressive combine driving toward new methods, new ideas and new markets.

BUILDING-BLOCK MACHINE TOOLS

England's situation is typified by the machine-tool industry, which is considerably like our own: many small plants producing quality and somewhat costly designs, with continuous improvement and refinement but few

FIRST AWARD of the Duke of Edinburgh's Prize for Elegant Design was made for the "Packaway" refrigerator of Prestcold Div, Pressed Steel Company Ltd, designed by C. W. F. Longman of the Engineering Dept. The judges particularly noted "the absence of self-conscious 'streamlining' and 'styling,' coupled with almost classical proportions." It is a 3-cu-ft unit with steel cabinet and plastic liner, costs $133 plus $24 tax.

FRANK GRIFFITHS
Chief production development engineer
Austin Motor Co Ltd (BMC), Birmingham

"Unless the design parts are highly stressed, metal has 'had it.' We can make parts more cheaply of plastics. Steel costs 8 pence a pound, nylon 84, but nylon weighs only a seventh as much and results in far less scrap than the 50% we get from steel. Thus material costs are comparable. Polypropylene and like materials are half as costly as nylon. But we must design cheaper extrusion presses; cost of a commercial unit is two-thirds in the die-opening hydraulics, only one-third in the press itself. So we'll buy or make only that third, and add a cheap die closure."

N. A. H. STACEY, (right), head
Economic Marketing Research Unit

V. G. BURCHILL, asst publications mgr
General Electric Company, London

"76% of British households have no refrigerators; those that do usually have 3½- or 4-cu ft units without frozen food storage. Our primary problem is not to sell new refrigerators, but to sell refrigeration as an idea. Modernization of homes here has been slow—perhaps because the discount house which offers your people 'savings' in purchases has no English parallel."

EDWARD BOWYER
Director & chief executive
Society of British Aircraft Constructors, London

"Only 50% or less of our aircraft orders are from the government, compared with your 80%. We have had 13 amalgamations in 18 months, are cutting labor force 800 men a month. Our hope is superior engineering, so we can sell from export. Too few of our people realize that selling engineering can be quite profitable. For example, ships—a traditional British product—bring only 14¢ per lb, autos ten times that. But machine tools bring $36 per lb, aircraft $42 and aircraft engines $50. So, in six years, we have doubled aero exports (£42 million to £100 million), tripled engine exports (£20 to £60 million). British aero engines are now on 52 types of foreign aircraft."

spectacular changes. The industry is accused of being laggard because of a good market for its solid, standard machines. The government department of scientific and industrial research has been in consultation with the industry, trying to step up its R & D effort.

Numerical control is still in the "talking stage," although EMI has developed a tape control used on Cincinnati millers, and several other makers are working on it. Tape-controlled-lathe users thus far are mostly small plants making limited runs. English measure is a continual problem, although most builders use both. Designs were standardized on metric bearings with the European market in mind, but this has boomeranged as sales to the US have increased. Now India has shifted to the metric system, so Commonwealth sales begin to amplify the problem (although one maker says the Indian shift is still theoretical, won't really be actual for 10 years).

Also, large buyers, like the automotive companies, are pushing building-block construction as the JIC has pushed it here, but somewhat more aggressively. Austin Motors, for example, has developed its own designs for building-block units and is making its own machines after trying unsuccessfully to get regular builders to produce units at a stated price. (The same procedure has been followed by Renault in France, but in West Germany, machine-tool builders make the "baukasten" units to automotive standards.)

Frank Griffiths of Austin (see picture) has been working on automation ever since World War II, starting as Renault did with the building-block concept rather than our original line-unit idea. He started on large units while Renault started on small flexible ones. "And," he says somewhat ruefully, "Renault put 80 engineers on the job—it's a government company—while we had to make do with three. First developed was a medium-sized head for a straight-line transfer machine. Outside bids were $2100 apiece in quantities of 25 or 50; Austin made them for a third that. This made a 2- or 3-head station cost $6000, as compared with $17,000 outside, or the American $22,500 to $25,000. The same units were later put in rotary machines. Now we're using the same principle on batch as well as continuous production.

"The next step was an engine lathe to size billets or blanks for cold forging. A simple lathe without gears or preoptive heads was produced for $1400. On the cold forging and forming itself, the ideal press was a hydraulic, but a 1000-ton unit cost $123,000. A mechanical press of the same size cost $45,000. Austin designed a simplified hydraulic unit of standard speed and pressure, with no frills, that cost only $21,500. For higher production we simply use a larger pump.

"We are working now on automation of the *relationship* of processes—the handling between steps. Based on magazine supply of components to a conveyor, we can do it for $6 to $8 per foot, and $6000 to $8000 per assembly station. Outside prices of twice that and more are sheer lunacy. We're considerably concerned about costs of automation—purchased machine tools have risen 25% in cost in five years. That can make an automated line cost more than the potential labor saving."

Griffiths is firm in his belief that the best a company can hope for is processes and equipment two or three years ahead of those of its competitors. He also feels that auto-

mation of assembly is the only hope for any quantity-production industry.

Col C. W. Clark, chairman of Alfred Herbert Ltd, Coventry, second largest machine-tool builder in the world, said in his annual report: "The conflict of interests of the European Economic Community on the one hand and the European Free Trade Area on the other has naturally caused us some concern in view of our substantial trade with all the free countries of Europe. Unless some way can be found of enabling the two groups to work together, it seems inevitable that some form of political schism will develop, which could have far-reaching effects on the prosperity and even the safety of Europe . . .

"There are no signs that our company's trade with the Common Market countries is in any immediate danger, but we . . . may, if necessary, consider . . . extending manufacture, possibly in France . . ."

Our own opinion is that the schism is already developing and that it is already having far-reaching effects on the prosperity of Europe—particularly on the Continent. **It has increased sales, providing money for engineering and research in German and French plants that England is not currently matching.** However, English makers take comfort in the fact that machine tools cost $3360 per ton in the US, $2800/ton in Switzerland, only $1680/ton in England.

ELECTRICAL, ELECTRONIC, COMPUTER

Or consider the electrical industry in Britain—a big and strong one. It is confusing to an American, because General Electric there has no connection with GE here (the former GE affiliate, British Thompson-Huston, being incorporated into Associated Electrical Industries, largest electrical company, which also includes Hotpoint—as a tradename only—and Metropolitan-Vickers). These companies have long designed to meet requirements of various countries. Electric & Musical Industries (EMI), for example, makes its TV equipment to both American and international standards. Its fully transistorized computers are designed to the metric system on the assumption that more markets are there.

John Sharp of Bulmers Calculators Ltd, London, on the other hand, laments the problems of converting Swedish (Addo) calculators from the decimal system to the 12-key setup needed for English money. The English company designs the "black boxes" and other devices, but they are made by Addo in Sweden. Bulmers, incidentally, patents only applications of circuits, not the circuits themselves, because a circuit patent can be circumvented by a minor change.

F. L. Westwater, deputy head of R & D for International Computers & Tabulators Ltd, London, feels the large computer hasn't too rosy a future. **"Ever larger and more costly computers are not the answer—the answer is higher-speed small ones.** Thus we are watching such new ideas as program interrupters, tunnel diodes, cryogenics and the thin-film parametron . . . In this field, the flow of technology is from the United States, not to you. Our first transistors came from you, as have other new components."

The British Treasury has published a standard for reliability of computers based on the number of hours of operation without failure, permitting preventive maintenance at regular intervals. Among recent computer installations reported from English sources is a twin setup at the French nuclear power station and another pair to control an ammonia plant and distillation setup.

Cancellation of the *Blue Streak* missile, after $170 million was spent (plus another $112 million in write-off), brought one utopian comment that it would have been better to have used the money in the beginning to encourage industrial modernization, leaving the Free World field to our *Polaris* and *Skybolt*. This is in sharp contrast to the French drive to its own missiles and nuclear weapons.

One interesting comment along this line from Robert Addie, chief engineer of EMI: **"US government money is the major research force in the Free World. If 'peace broke out,' all this might go, to the detriment of development. Your companies, however, seem to be undertaking research on their own that ours will not or cannot because of lack of funds.** Some of our attitude is of course conservatism—wearing blinders—but the Common Market may shake us up. Such commercial separation sooner or later leads to political separation. English people just couldn't believe that countries of such divergent habits and languages could get together, although Switzerland proved it possible long ago."

Strangely, the British plans are in general not to tie in at the engineering level with European companies, but to license or purchase subsidiaries, in contrast to the cross-licensing engineering agreements on the Continent.

ENGLAND'S INDUSTRIAL DESIGN

Although the Council of Industrial Design has been active for some years in Great Britain, and has had a central display in London for three years, its activities have been largely aimed at consumer goods. A. Gardner Medwin, head of the Industrial Division, has held conferences with textile-machinery manufacturers in Birmingham and Manchester during the past year, however, in which they accepted the idea of industrial design.

The Council has set up a sixth industrial officer for engineering, the post being held by W. H. Mayall. During his first months in office, the latter's activities have been largely economic, although he has now begun to develop human-engineering aspects. His research has indicated that this is a sensible area in which to begin because of the applicability of the concept to machine tools. Mayall feels that combining good industrial design with quality engineering and manufacture—a British tradition—can hold or improve export sales.

Increasing numbers of manufacturers are beginning to realize that appearance is important even on industrial products, particularly for export. Some consumer goods retain their appeal because of the traditional design, but industrial products must compete with functional and smart-looking contemporary equipment from the Continent.

In several cases, Continental designers have been brought in—for example, Austin-Healey has recently engaged Pinin Farina— leading some authorities to worry that future design may show too much foreign influence. They argue that some foreign influence is good, but there should be enough interpretation so the design is not a slavish copy. They insist that quality is still the major selling point; appearance must not subtract from that.

Switzerland . . .

Switzerland is a land of paradoxes, at once the most diverse and the most cohesive country in Europe, the most independent politically and the most dependent geographically. Its 15,940 sq mi are half Alps; 46.6% of the income of its 5,900,000 people is from manufacturing, 16½% from agriculture. Some 72% of its population speaks German, 21% French, 6% Italian and 1% Romansch, but it has been stubbornly neutral through two world wars. It has been a true republic since its founding in 1291. Its largest city, Zurich, has only 414,000 people; its second city, Geneva, has 157,300, yet 120 of 300 American companies in Switzerland have offices there (150 in Zurich) and it is the seat of the UN in Europe, of the International Standards Organization, International Electromechanical Commission, International Telecommunications Union.

Invited to join the Common Market, Switzerland refused for three reasons: two ideological, one practical. It felt political union might result (anathema to Swiss), that the assignment of voting power to members (4 votes each to Germany, France and Italy, 2 each to Belgium and Holland, 1 to Luxemburg) was not truly democratic, and that joining one trade group at favored tariffs would inevitably cause trouble with other countries and groups. Switzerland has joined the Outer Market, but only half-heartedly as a measure of protection. (In a recent Lausanne survey, 18% of the people placed Switzerland correctly in the Outer Seven, 11% put it in the Common Market, 36% had never heard of either, and the rest had only a vague idea.) Because Switzerland has no natural resources, practically speaking, except "its scenery and its people," and import and export are the life blood of its manufacturing economy, the present position is extremely difficult. Some six major Swiss companies, in fact, when they discovered the central theme of my questioning, denied interviews because they "had no knowledge," or "the proper executive is away," or plainly because they had "no comment." Those who did speak are worried about the situation and hope for an all-Europe market, or have already taken practical steps to cope with, or circumvent, it. It is obvious that exports of traditional products with low engineering content will be endangered. These include textiles (made cheaper in Italy and France), chocolate and dairy products.

Switzerland, like all neighboring countries, is booming. She has at present a half million foreign workers within her borders—the maximum (10% of population) that the Council will permit—so it is obvious there is plenty of work. Most of this labor is Italian for unskilled work, but many Germans and Austrians do skilled and professional work as engineers, technicians or draftsmen. The Swiss belief that their country is for Swiss, not outlanders, keeps this labor mostly in the menial jobs.

The basic feeling among Swiss engineers is that the technical content of their products is so high that tariff walls make little difference. They point out that France, Italy and England have all had very high tariffs, and still Swiss designs have been sold in quantity to these countries. Case in point: Brown-Boveri, Oerlikon and Sécheron can produce 1500 megawatts of generating equipment a year,

WALTER M. Von ORELLI
Director, Assn of Swiss Machinery Industries, Zurich

"Exports of the Swiss machinery industry are about 40% to the Common Market, 15 or 16% to the Free Trade area. For other engineered products, I'd guess the figures are much the same. We, therefore, feel that joining the Common Market would not be particularly helpful. While we do not report such statistics as you do, I'd guess that 65% of all Swiss-made machinery is exported. We expect little trouble, because our machines are, in general, very specialized and have high engineering content. Machinery is almost a third of all Swiss exports—31.4% last year."

EUGENE TEANRENAUD
Commercial director
Longines Watch Co, St Imier

"Basic research for all Swiss watch companies is done by HLSRH in Neuchatel. This central research organization also has committees working on standardization of gear-tooth shapes and forms and like parts. Big makers like Longines and Omega have their own standards of many years standing, however, so it is hard to get agreement, even though all watch mechanisms are basically similar. Our industry has been so competitive that we have been forced to keep our designs very up to date, so the Common Market will not hurt us seriously, but the small plants and unchanging industries like textiles will suffer. Some 70 Swiss watch assemblers—the smaller companies—have formed an association to standardize design of gears and other small parts among themselves, thus permitting quantity manufacture and cutting costs."

JEAN BESATI
Technical director
Reno SA, La Choux de Fonds

"Our attitude toward the Common Market is one of watchful waiting. We believe our designs will make or break us. We have just completed, for example, a watch-timing machine that gives instant readings rather than requiring charting as present machines do. We've also developed a very small motor operated by a flashlight cell that costs only $2, and a flashlight-battery-operated clock that uses the same principle. The clock has a ball-shaped case of two plastic halves that simply snap together, will run accurately for several months. These three products represent as many markets. Also we have a plant in France, plan one in Germany, and the border of France is only 10 km away."

(Right) **RENE le COULTRE,** chief, Technical Div,
(Left) **RENE CUENDET,** asst export mgr
Swiss Watchmaking Federation, Bienne

"The Swiss make 40 million watches a year, the French six million, Germans five million, Italians a half million, plus gold-filled cases and jewels. Most of the ideas and machines are Swiss in origin, and most Common Market watches (like the Russian, incidentally) are the medium grade. With the Common Market in the offing, they probably could build up their industry in 10 years to produce 30 million watches. So we called a meeting, pointing out that such a procedure would force us to take counter-measures. We have a gentlemen's agreement not to tread on each other's toes. That will serve for now."

Switzerland can absorb 500 to 800. So the rest must be exported.

Director Naegelt, of J J Rietier, Winterthur, largest Swiss textile-machinery maker, reports no effects thus far from the Common Market, but Director Zollikofer of Georg Fischer, Schaffhausen, says French sales have dropped off. The Swiss Electrotechnical Commission, mindful of Anglo-American and Scandinavian-bloc pressures in standards work through the years, has been contacting EFTA members to warn that they may have to take combined action to resist Common Market pressures on standards. However, the Machinery Association feels this will not occur. The ISO has been extremely slow on standards, in Swiss opinion, largely because it has no authority to enforce them. Meanwhile, DIN are widely accepted in Common Market countries, so that they could readily become Common Market standards. However, Swiss engineers are not too concerned over this possibility, because heavy machinery is already made to these norms.

Common-research programs are beginning to appear in various parts of Europe since AEG and Siemens began

J. HUBER
Secretary-General
Paillard SA, Yverdon

"This is an old company, founded in 1814, and now the largest in French-speaking Switzerland. Once we made watches and music boxes, then photographic equipment, radio and tv, but since 1954 we have made only Hermes typewriters and Bolex movie cameras and projectors. We export 85% of our typewriters, made at this plant, and 95% of the movie equipment, made at St. Croix. On the latter, we work with SOM Berthiot of France, so this should ease Common Market problems. We can shift as demand shifts—we must, because we employ 1800 people in Yverdon, which has only 15,000 people."

OTTO ZOLLIKOFER, director (right); **K. NOHL,** sales engineer; **Dr H. T. RENKER,** research director (left)
Georg Fischer AG, Schaffhausen

"We are concerned, because 96% of our business (machine tools) is export. We hope there will not be an Inner Six and an Outer Seven, but a Combined 13; the present setup is impractical and undemocratic. Extensive technical interchange has gone on with other countries for several years past; research director Renker has just returned from a technical lecture in France, for example."

Engr WILLIAM KLEIN
Asst to the sales director
Brown-Boveri & Co, Baden

"We have plants in France, Italy and Germany, so we can handle Common Market problems on most lines. However, all our research and administration are here, as well as our heavy-machinery departments. Our emphasis has always been on engineering, and this ability knows no nationality nor any tariff."

their combined program on research and development of radio, TV and tape recorders through Telefunken. The HLSRH laboratories in Neuchatel have already been mentioned. Escher-Wyss and Charmilles have begun a common research laboratory for turbines. Oerlikon is also reportedly considering reduction of its lines to those in which it has particular skill or knowledge, abandoning those which will face heavy Common Market competition. Two leading makers of low-voltage (domestic and industrial) switchgear have decided that "elimination of duplication of effort in research, development and manufacturing is an urgent need and a necessary step to meet the new market conditions in Europe." So Gardy S A of Geneva will make switchgear and Adolf Feller of Zurich will make accessories, in each case to be sold by both.

how this study was made . . .

McGraw-Hill World News men in major cities of six countries were given a theme, some general questions and a proposed itinerary. They selected key men in representative industries, made appointments, provided transportation, interpretation and explanation where necessary, explained local customs and ideas. (Most of the interviewees spoke English, but there were the usual problems of idiom and technical terminology.)

A major problem was schedules, because of geographical distances between calls, fixed times of appointments, understandable reticence of interviewees, and the odd (to us) hours of many European executives—roughly 8 to 12 noon and 2 or 3 to 7 PM. Because of the character of the questions, the usual interviewee was a top executive, sometimes in administration (secretary-general), sometimes in sales (commercial director), but most often technical director. The latter is a difficult title to explain in American terms; it corresponds to a vice-presidency of both engineering and production, plus board membership. (European companies are usually headed by a director, supported by a commercial director and a technical director—all three engineers.) The companies and men visited:

FRANCE

European Productivity Agency (Div OEEC)—Paris
- Dr Alexander King, deputy director
- Dr Joachim Hennenhoefer, head, Applied Research Committee

Delegation General a la Recherche Scientifique et Technique—Paris
- M. Villecourt, asst to Delegue General

General Motors—France—Gennevilliers
- M. Krause, chief engineer (one of seven Americans there)
- Eric Tussier, public relations officer

Renault Motors—Billancourt
- Fernand Picard, chief engineer (also pres, SIA—like our SAE)
- Several design and production engineers, press officers

H. Ernault-Batignolles—Paris
- A. LeLan, technical director
- Rene Le Brusque, chief engineer
- M. Berly, asst chief engineer

Nord Aviation—Chatillon-sur-Bagneux
- Noel Daum, technical director & vp, engrg
- Emile Stauff, technical chief, Tactical Missiles
- Jacques DuPin, technical chief, Supersonic Aircraft & Strategic Missiles

Compagnie de Machines Bull—Paris
- Philippe Dreyfus, technical director

Compagnie Generale de Telegraphie Sans Fil (CSF)—Paris
- Pierre Braillard, secretary-general

Compagnie d'Esthetique Industrielle—Paris
- Bernard Laurent, director

Societe d' Esthetique Industrielle—Paris
- Philippe Charbonneaux, head

Peter Muller-Munk—Paris
- (American industrial designer working for EPA)

GERMANY

Opel Motors (GM)—Ruesselsheim
- Hans Mersheimer, chief engineer
- H. Reimann, press officer

Battelle Institute—Frankfurt-am-Main
- Prof Max Barnick, director

German Machinery Mfrs Assn (VDMA)—Frankfurt
- Dr Heinz Weigel, economist on machine tools
- Dr Justus Fuerstenau, Foreign Trade Dept
- Hans Georg Staecker, Foreign Trade Dept
- Hans Leitner, press chief

AEG, Frankfurt-am-Main
- Dr Bernhardt Kalkner, general manager, Engrg

Friedrich Krupp—Essen
- Dipl Engr Robert Lotz, head, development
- Dr Otto E. Ruediger, director, Essen Research Center
- Hans-Heinrich Campen, press officer
- Herr Burendt, press chief
- Herr Stefani, administrative staff
- Herr Koch, technician training

Haus der Industrie-forme, Essen
- Dr Huedinger, director, Villa Huegel
- Dr Mahlberg, director

Schiess AG, Duesseldorf
- Dr Engr Helmut Elenz, chief, Machine-tool Production
- Dipl Engr Guenther Voelker, head, Service Engrg
- Dipl Engr Ernst Grund, director

Verein Deutscher Ingenieure—Duesseldorf
- Dr Engr Erich Schlobach, Standards Committee (also VDMA)

Reifenhauser AG—Troisdorf
- Fritz P. Kaerger, chief engineer

ITALY

Fiat Motors—Turin
- Dante Giacosa, technical director, Automotive Div.
- Franco Givra, asst technical director, Aviation Div.
- Tito Ivaldi, asst technical director, Aviation Div.
- Dr Gino Pestelli, director, Direzione Stampa e Propaganda

Pinin Farina—Turin
- Giovanbattista Farina, head
- Sergio Farina

Piaggio & Cia—Genoa
- Prof Dr Ing G. P. Casiraghi, technical director

Olivetti—Milan
- Dr Richardo Musatti, director, Engrg
- Ettore Sottsass, architect (industrial designer)

Innocenti—Milan
- Dr Ing Massimo Scortecci, technical director, Mech Div
- Ing S. Sala, press chief

Stile e'Industria
- Architect Carlo Rosselli, editor

BELGIUM

European Economic Community—Brussels
- Pierre Pujade, Div of Harmonization of Legislation

Bell Telephone Mfg Co—Antwerp
- B. Willemans, automation project mgr

Construction & Importation Vehicles Automotive (CIVA)—Antwerp
- M. Debbaut, administrative secretary

GREAT BRITAIN

General Electric Company (GEC)—London
- V. G. Burchill, asst publications mgr
- N. A. H. Stacey, head, Economic Marketing Research Unit
- M. Winnett, head, Appliance Design Center

Austin Motor Co (Div BMC)—Birmingham
- Frank Griffiths, chief production development engineer

Associated Electrical Industries—London
- J. A. Saltmarsh, market research mgr—Hotpoint
- Stanley White, press officer

Wickman, Ltd—Coventry
- G. E. Butler, export sales mgr

H W Ward & Co, Ltd—Birmingham
- H. Thorneloe, sales executive

Bulmers Calculators Ltd—London
- John Sharp, chief technical consultant

Electrical & Musical Industries Ltd (EMI)—Haynes, Middlesex
- Robert W. Addie, chief of design
- Tom West, press relations officer

International Computers & Tabulators Ltd—London
- F. L. Westwater, head, R & D

Society of British Aircraft Constructors—London
- Edward Bowyer, CBE, director & chief executive
- Alec Johnson, press information officer

Council of Industrial Design—London
- A. Gardner Medwin, head, Industrial Design
- W. H. Mayall, industrial officer, Engineering

SWITZERLAND

Assn of Swiss Machinery Industries—Zurich
- Engr Walter M. von Orelli, secretary

Swiss Federation of Watch Mfrs—Bienne
- Rene Cuendet, asst export mgr
- Rene Le Coultre, technical consultant

Cie des Montres Longines, Francillon SA—St Imier
- Eugene Teanrenaud, commercial director
- Several engineers

Reno SA—La Choux de Fonds
- Jean Besati, technical director
- Several engineers and research men

Paillard SA—Yverdon
- J. Huber, secretary-general

Brown, Boveri & Cie—Baden
- Wm Klein, asst to the sales director

J. J. Rietier—Winterthur
- M. Naegelt, director

Georg Fischer Ltd—Schaffhausen
- Otto Zollikofer, director
- Dr H. T. Renker, research director
- Georges N. Zwez, asst sales mgr
- Fritz Oerth, chief sales engineer
- K. Nohl, sales engr

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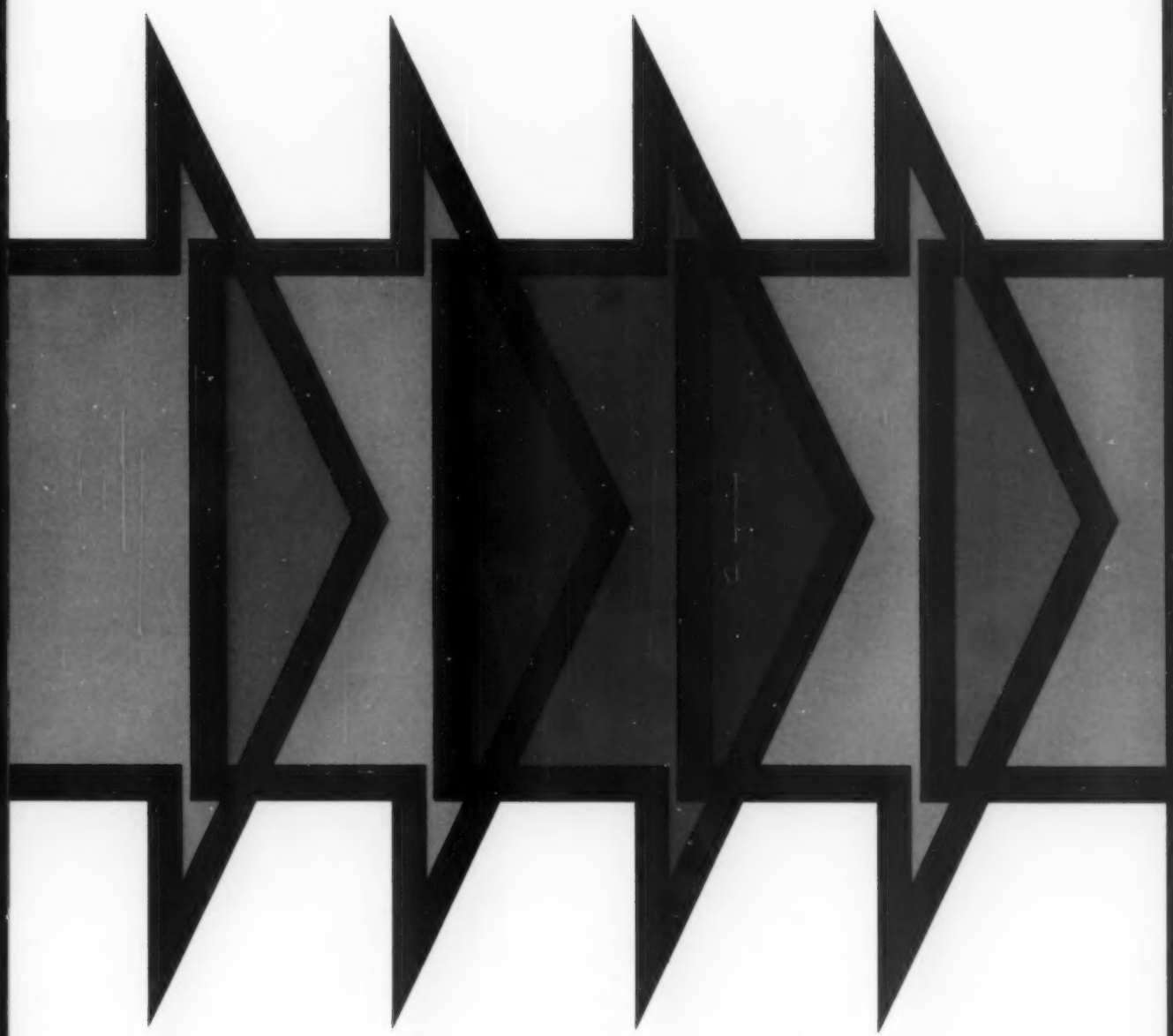
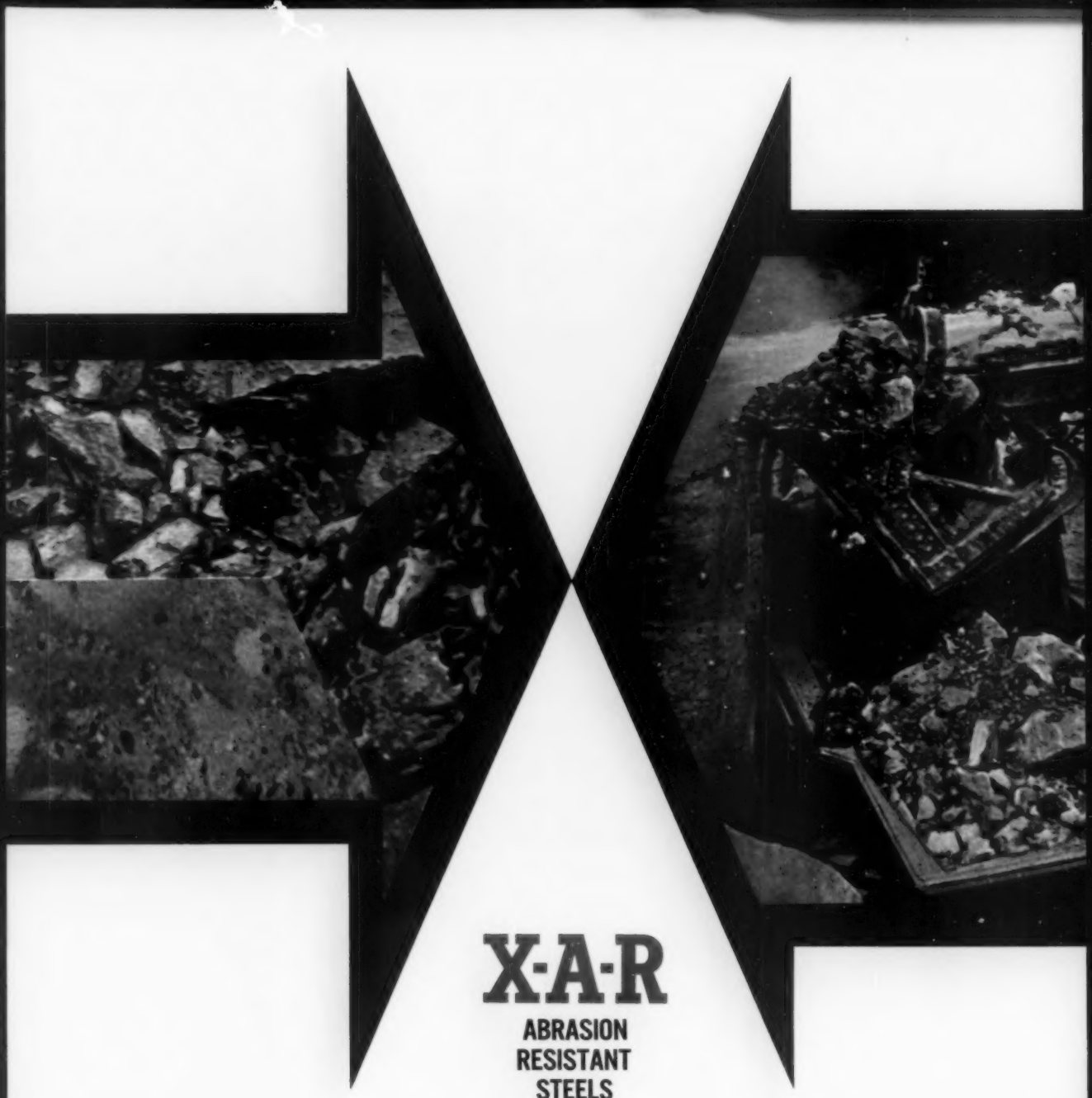


FROM GREAT LAKES STEEL

15 X-A-R 30
ABRASION RESISTANT STEELS

TWO NEW STEELS—HARDER FOR HARDER JOBS



X-A-R

ABRASION RESISTANT STEELS

HARD ENOUGH AND TOUGH ENOUGH TO LAST

Is abrasion your constant enemy? If your equipment meets materials as they're scooped, shoved, slid, pushed, dragged or dumped, does it face the recurring threat of downtime for repairs or replacement? To eliminate such maintenance headaches, Great Lakes Steel has developed two tougher, harder alloy steels—X-A-R 15 and X-A-R 30. They're supplied in hardnesses from 360 to 400 BHN (or, by agreement, in a range of hardness between 265 and 500 Brinell). And they're especially effective and economical in those critical bear-the-brunt areas of the equipment where wear is worst—liners, teeth, bars, blades and plates, for example. *Under conditions that commonly wear out equipment in a hurry, X-A-R abrasion-resistant steels outwear any other type of steel.*

Great Lakes Steel is a division o

WHERE MATERIALS COLLIDE WITH EQUIPMENT

Chemical composition alone is not the secret of low carbon X-A-R steels; their balanced combination of uniformity, high strength, hardness and toughness is the result of close control during heat-treating, quenching and tempering. This makes them more workable, too. Under normal welding and fabricating conditions use X-A-R 30. For *extremely* difficult problems, such as welding under cold conditions or extensive flame cutting, choose X-A-R 15.

X-A-R abrasion resistant steels are immediately available in $\frac{1}{8}$" to 1" thicknesses, widths up to 72" and lengths up to 35'. For technical information and supply sources, see next page.

X-A-R

A PRODUCT OF

GREAT LAKES STEEL

Detroit 29, Michigan

NATIONAL STEEL CORPORATION

15 X-A-R 30

TECHNICAL INFORMATION

CHEMICAL COMPOSITION

X-A-R steels are furnished at two specified carbon ranges. These are 14 to 20 carbon for X-A-R 15 and 25 to 30 carbon for X-A-R 30. The balance of the typical composition is:

Manganese	.80%	Chromium	.65
Phosphorous	.020	Molybdenum	.20
Sulphur	.028	Zirconium	.06
Silicon	.60		

TYPICAL MECHANICAL PROPERTIES

	At Brinell Hardnesses of: 363	400
Tensile Strength, psi	180,000	200,000
Yield Strength, psi	165,000	180,000
% Elongation in 2"*	17	16
% Reduction in Area*	56	55
Charpy V Impact at —75°F.	12 (Ft. Lbs.)	7

*Based on standard .505" specimen

ENGINEERING DATA

Resistance to Atmospheric Corrosion (Rural, Marine, and Industrial Environments)	3-5 times copper-bearing or carbon constructional steel
Compressive Yield Strength, psi	Approx. equal to Tensile Yield Strength
Ultimate Shearing Strength, psi	Approx. equal to Tensile Yield Strength
Modulus of Elasticity, psi	29/30,000,000
Endurance Limit (rotating beam)	60% of Tensile Strength
Coefficient of Expansion per °F.	70°F. to 200°F.—.0000062

FABRICATION

Cold Bend Test: Moderate bending can be performed within the usual range of hardnesses. For free bending, it is recommended that a mandrel be used not less than ten times the thickness of the metal through an angle of 90°.

Welding: Low hydrogen electrodes are recommended for welding X-A-R steels. The grade of electrode used is dependent on the strength requirement of the weldment.

Burning: X-A-R steels can be flame cut without pre-heating or stress relieving after cutting.

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In addition to the information given in this folder, there is a great deal of detailed data available to steel users covering all characteristics of X-A-R steels. Furthermore, a thoroughly competent metallurgical service organization is available to work with you on any application problem you may have.

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Los Angeles, California

INTERSTATE STEEL COMPANY
Evanston, Illinois

LOCKHART IRON & STEEL COMPANY
Pittsburgh, Pennsylvania

MARSH STEEL & ALUMINUM COMPANY
Kansas City, Missouri

O'NEAL STEEL, INCORPORATED
Birmingham, Alabama

SALT LAKE HARDWARE COMPANY
Salt Lake City, Utah

A. C. LESLIE & COMPANY, LIMITED
Montreal, Canada

15 X-A-R 30
ABRASION RESISTANT STEELS

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I need it too!"

Everyone concerned with temperature control will want to read this new Fenwal Bulletin, "Smarter Looking — Smarter Acting Electronic Temperature Controllers and Indicators."

These modern transistorized instruments with thermistor sensors can be *more precisely matched* to requirements over a range from −50 to +600°F. Their many interchangeable, optional features let you order *exactly* what you need. And you can *combine* instruments . . . "build" to your specifications.

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Get your copy of "Smarter Looking — Smarter Acting." Then get the *benefits* of this versatile new instrument family. Write FENWAL INCORPORATED, 536 Pleasant Street, Ashland, Mass.

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Here's another bonus: a full-time design and service engineering group is ready to help design your specific use of Johnson's bimetallics.

Contact us for more information on how Johnson Bronze Co. can help serve your power transmission needs.

Johnson Bronze Company

New Castle, Pa.

West Coast Plant: Oakland 8, Calif.

NAMEPLATES: a tabulated guide

Table compares characteristics of nine commonly used types of nameplates.

PETER C NOY, *technical representative*
Nicromatic Ltd
Toronto, Ont

The purpose of a nameplate is to give information about, and to decorate, a product. Because it is a part of the product itself, general appearance, durability and price must match the product.

The amount of information that can be shown on a nameplate depends upon the legibility and image size that the process permits. Its decorative value depends upon its color, reflectivity, and shape. Its durability is a function of the material of which it is made and its method of attachment.

As a guide to the selection of nameplates, the following table outlines the way in which the commonly used kinds measure up to requirements. The table is a good first guide for the design engineer. A final decision will depend upon the over-all appearance, testing and price.

The type of nameplate in the first column refers to the way the design or artwork is reproduced, rather than the way the whole plate is formed.

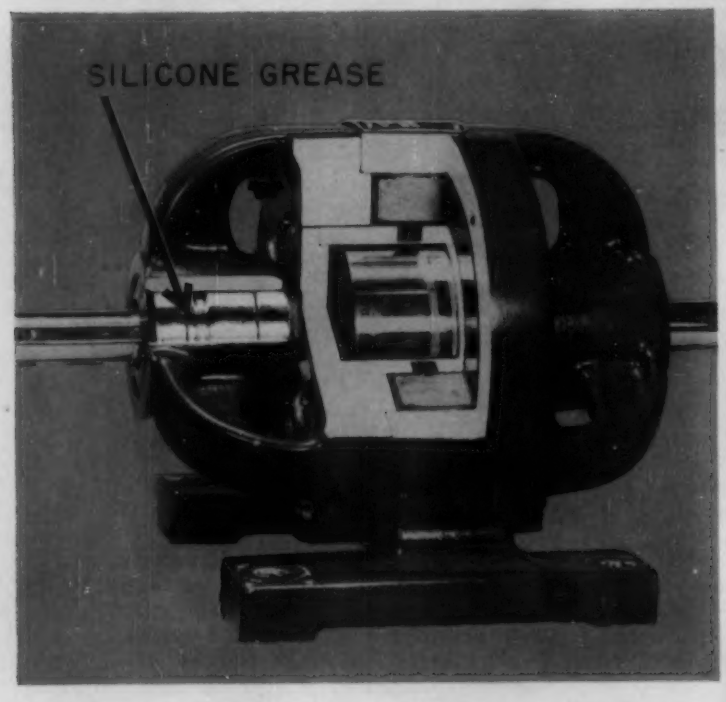
The relative costs quoted depend upon the degree of quality required within the particular type. When setting the cost, keep in mind the degree of quality generally required.

TYPE	INFORMATIVE VALUE	DECORATIVE VALUE		DURABILITY
Plastic Moldings **Cost:** Low to medium	**Legibility:** Good—very fine definition of etched type is lacking, comparable to coined plates **Image:** Excellent—very small characters may be reproduced	**Color:** Excellent—separate inserts of jewelled, transparent or translucent plastic, paint-backed clear plastic, etc; avoid overdecoration **Shape:** Excellent—intricate bas-relief possible	**Reflectivity:** Good—may be vacuum-plated or highly finished as molded **Solidity:** Good	**Materials:** Good to excellent—corrosion resistance may be high but abrasion resistance generally lower than metals **Attachment:** Fair to good—rivets, screws, adhesives, lugs on part, etc.
Thin plastic **Cost:** Low	**Legibility:** Excellent—the offset printing and photographic processes used give top results **Image:** Excellent—very fine detail because of printing process	**Color:** Excellent—three- or four-color systems are mass-produced easily **Shape:** Fair—they can conform to gently curved surfaces	**Reflectivity:** Good—metalized films are used underneath clear plastic films in conjunction with printing **Solidity:** Poor—thin and flat	**Material:** Fair—polyester films used are quite tough, but will not stand much mechanical abuse or heat **Attachment:** Fair—exclusively by adhesives; may be troublesome in hot or corrosive surrounding

continued, p 93

SILICONE NEWS from Dow Corning

Lubricants That Last



LONG SHELF LIFE—Lubricated with silicones, timing devices, made by Appliance Manufacturing Co., for automatic dryers, operate accurately and quietly after extended storage.

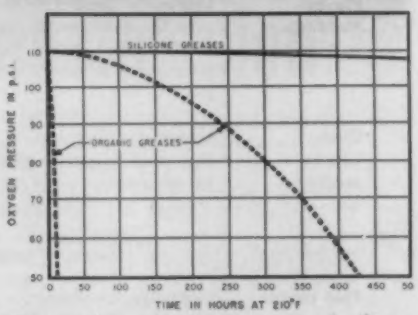
HEAT & COLD—Silicone lubricants prevent locks on parking meters from freezing up . . . eliminate lubrication problems.

Silicone Lubricants Beat the Heat... Won't Oxidize In Service or On Shelf

Typical of the new designs made trouble-free with the aid of heat-stable Dow Corning Silicones is the magnetic clutch shown above. Manufactured by Vickers Incorporated, Electric Products Division, Sperry Rand Corp., St. Louis, Mo., this clutch can slip continuously, and therefore, must dissipate heat . . . heat that is conducted to the ball bearings. To lubricate these bearings, Dow Corning silicone grease was specified because it doesn't thin out and run away when temperatures skyrocket. Nonoxidizing, silicone grease remains operable for many years despite continuous temperatures of 450 F and higher.

YEAR 'ROUND LUBRICATION . . . INDOORS AND OUT. Silicone lubricants withstand both cold and heat . . . give all-year lubricity to outdoor mechanisms such as parking meters. Viscosity of silicones remains virtually constant down to —100 F . . . won't stiffen. Silicone lubricants also provide excellent shelf life, thus assuring instant starts for equipment left in storage for extended periods.

If your special design encounters any of the conditions just mentioned—high heat, cold, extended shelf life, weathering — a Dow Corning silicone grease will probably end your lubricating problems on metal, plastic or rubber parts. Send for literature, or outline your lubrication problem on your letterhead and we'll send you a free sample. Be your own judge. Address Dept. 7208 today.



The excellent oxidation resistance of silicone lubricants is shown above. After 500 hours of exposure to oxygen under 110 psi at 210 F, with a brass catalyst, silicone lubricants caused a pressure drop of only 1.5 pounds.

The nearest Dow Corning office is your number one source for information and technical service on silicones.

first in silicones

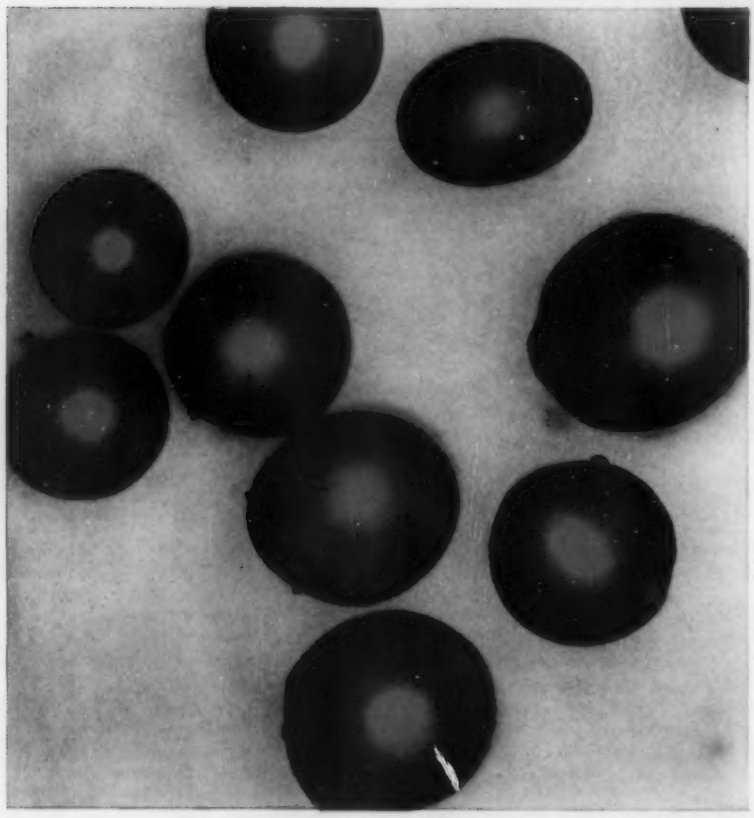
Dow Corning CORPORATION
MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D. C.

NAMEPLATES continued

TYPE	INFORMATIVE VALUE	DECORATIVE VALUE		DURABILITY
Painted decals **Silk screen** **Offset printing** **Cost:** **Varies widely with quantity**	**Legibility:** Excellent **Image:** Excellent	**Color:** Excellent—multicolored legends are easily produced **Shape:** Poor—they must have a flat surface to attach to	**Reflectivity:** Poor—decals are usually applied directly to the product **Solidity:** Poor—the best result is that of a printed legend	**Material:** Fair—only as good as the paint **Attachment:** Fair—very slick surfaces such as chromium plate must be avoided
Etched sheetmetal **Cost:** **Medium to high**	**Legibility:** Excellent—the etching process reproduces accurately the finest line and half-tone detail **Image:** Excellent—maximum detail per unit area	**Color:** Excellent—paint filled areas and multi-color anodized **Shape:** Good—limited only by drawing and forming possibilities of the metal	**Reflectivity:** Excellent—buffed, polished, satin, or pressworked matte backgrounds **Solidity:** Fair—deeply etched lines give substantial look; may be formed	**Materials:** Excellent—silver, gold, copper, aluminum; harder metals not often used because of die wear **Attachment:** Good—lugs or pins on nameplate, soldered, adhesives; but seldom welded or bolted
Etched foil **Cost:** **Low**	**Legibility:** Excellent—same as etched sheet metal **Image:** Excellent—same as etched sheet metal; lines and characters in both approach fine printing on paper	**Color:** Good—some limitations on paint filling of etched-out areas; color anodizing predominant **Shape:** Fair—can conform to gently curved surfaces, but usually flat	**Reflectivity:** Good—thinness of foil limits buffing operation **Solidity:** Poor—thin and flat	**Materials:** Good—mostly aluminum foil anodized selectively and dyed **Attachment:** Fair—adhesives exclusive in this type; can give trouble in hot and corrosive surroundings
Cast **Cost:** **Low to medium**	**Legibility:** Poor to good—depends upon the type of casting; sand-cast nameplates, for example, will require large letters and lines, with coarse radii, pressure diecast plates offer excellent detail	**Color:** Good—may be paint-filled in various colors **Shape:** Excellent—limited only by casting possibilities	**Reflectivity:** Fair—highlight buffing is normal **Solidity:** Excellent	**Materials:** Excellent—brass, copper, aluminum, steel, magnesium, etc; thick sections have great durability—good for heavy machinery in rough environment **Attachment:** Excellent—bolts, rivets, machine screws; substantial attachment matches nameplate to product
Pressworked **Cost:** **Low**	**Legibility:** Good—embossed lettering on metal parts often used to identify manufacturer, rating; decorative scrolls common on appliances; formed depressed or raised letters require radii **Image:** Fair—male punch tool limited in cross section for embossed lettering	**Color:** Good—separate masking may be used for multicolor paint; depressed lettering often paint-filled **Shape:** Excellent—limited only by drawing and forming qualities	**Reflectivity:** Excellent—parts may be buffed and plated easily, or made of highly finished metal. **Solidity:** Excellent	**Materials:** Good—brass, plated steel, stainless **Attachment:** Good—usually riveted, fastened with adhesives, or snapped onto the part.

30 MILLION OF THESE JET-FORMED SPHERES IN EVERY INCH OF BEARING SURFACE!



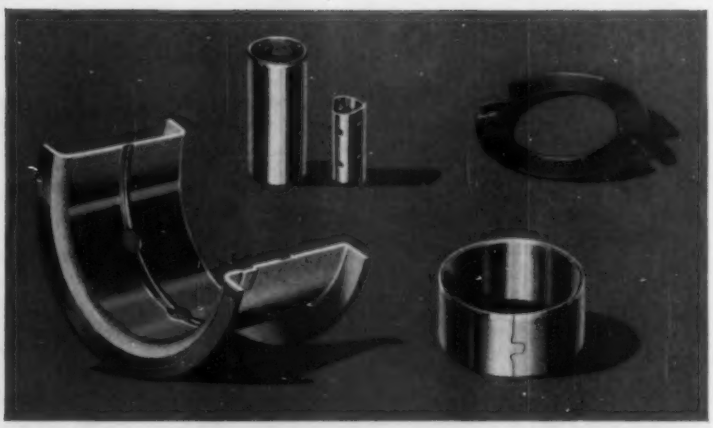
JET PROCESS BLASTS MOLTEN ALLOY INTO UNIFORM PARTICLES . . . so small that thirty million will form a thin layer only one inch square! This sintered layer is the bearing surface of Federal-Mogul sleeve bearings.

Molten copper-lead, alloyed to exact specifications, is poured into a special inert-atmosphere reaction crucible. Here it's blasted by a high-speed fluid jet to form the dense powder shown at left.

Because of the uniform particle size of this powder, the bearing surface of each F-M copper-lead sleeve bearing has precisely the same alloy composition and high adhesion to the steel backing as every other F-M bearing of the same alloy type!

YOU CAN SEE THE CONSISTENT SIZE in the photomicrograph. What you *can't* see is the consistent alloy composition which produces uniform bearing properties and performance in any alloy type.

Federal-Mogul makes engine bearings for every condition of speed and load. You can select from among five different sintered copper-lead alloys, all permanently bonded to precision-formed steel backing. Our Engineering Department is available to you for consultation or recommendations on bearing design and application. For more information, write Federal-Mogul Division, 11043 Shoemaker, Detroit 13, Michigan.



A COMPLETE LINE! Steel backed bearings with a selection of many different alloys for virtually any bearing application—Plain and bimetal bushings in bronze, steel or aluminum. Precision thrust washers in solid bronze, or sintered alloys on steel (one or both faces). Rolled split spacer tubes in steel, aluminum or stainless.

FEDERAL-MOGUL

sleeve bearings
bushings-spacers
thrust washers

DIVISION OF
FEDERAL-MOGUL-BOWER
BEARINGS, INC.

SIGNIFICANT COMPONENTS MATERIALS, PROCESSES

Spacer couplings . . .

are equipped with detachable hubs that permit coupling of shafts spread as far apart as 7½ in., depending on coupling size. Spacer couplings can also be removed without disturbing shaft alignment. Consists, like standard couplings, of two flanges and two-piece flexible rubber sleeve. Shaft ends fit into hubs and each hub is attached to coupling flange by four cap screws. Reported to withstand 5 to 15 times more shock and vibration than other flexible couplings; to withstand all types and combinations of misalignment without wear or internal abuse; to take angular misalignment up to 1°, parallel misalignment up to 1/16 in., free-end float up to ⅛ in. Standard couplings range from min stock bore of ⅜ to max bore of 3¼ in. Price range is $10 to $150 each. Delivery, 2 to 3 wk. **T B Wood's Sons Co, Chambersburg, Penna.**

Circle 300 on Reader Service Card

Fiberglass flake coating . . .

is a homogeneous mixture of flake, resin, fillers, accelerator and pigment that can be applied to metals, wood or concrete for protection against corrosion. As normally applied by special spraying equipment, 20-mil coating is said to have 50 layers of flake, with a dielectric strength of 500 v per mil. Available in pilot plant quantities. **Owens-Corning Fiberglas Corp, 717 Fifth Ave, New York 22.**

Circle 301 on Reader Service Card

Linear display . . .

offers full-range display of cutting tool or workpiece position. Numerical control system can be adapted to existing as well as new machines. Automatically performs calculations for rotary and linear positioning. Utilizes position feedback transducer, electronic circuitry and visual display to indicate actual position of tool or workpiece. Actual position is displayed in straight decimal form by illuminated numbers said to be readable from 20 ft. **Data Systems Dept, Norden Div, United Aircraft Corp, Santa Ana, Calif.**

Circle 302 on Reader Service Card

Gasketing, packing materials

made of fluorocarbon resins and inorganic fibers can be used at temperatures from —425 to 500 F. Said to have excellent torque retention and to be unaffected by common fuels, lubricants, hydraulic fluids or solvents common to many industrial processes. Can be bonded to other materials with thermoplastic or thermosetting adhesives. Patented beater saturation process produces uniform coating of each inorganic fiber and even distribution of fibers to form uniform material. **Armstrong Cork Co, Industrial Div, Lancaster, Penna.**

Circle 303 on Reader Service Card

Miniature temperature control

operates on expanding-tube principle, which allows for fast heat-transfer response time. Standard setting tolerance is about 5 F, depending upon balance of electrical circuit involved. Has contact rating of 1 amp, 115 v ac, temperature range to 500 F. Measures 1½ in. long and ¼ in. dia. Flange is ⅞ in. OD. Weighs 0.5 oz. Can be hermetically sealed. Said to meet MIL-S-5272-A. **Scaico Controls Inc, Taylor St, Riverside, NJ.**

Circle 304 on Reader Service Card

Flow transducers . . .

utilize opposed-bellows meter body in conjunction with potentiometer winding to provide output signal directly proportional to flow. Total resistance values from 500 to 5000 ohm are available, depending on specific requirements. Differential-pressure ranges from 0 to 20 in. water to 0 to 500 psid can be accommodated with corresponding flow ranges. Full overrange protection to 5000 psig can be provided for most ranges. Linearity for all ranges in excess of 0 to 50 in. water differential pressure will be within 0.5% of total flow from 20 to 100% of flow. Resolution is within 0.1% of total flow from 20 to 100% of flow. **H E Sostman & Co, 347 E Lincoln Ave, Cranford, NJ.**

Circle 305 on Reader Service Card

¼-in. hand cone valve . . .

has stem that terminates in socket, which holds knuckle of conical-shape plug. With plug firmly seated at closure, stem is free to rotate on knuckle surface. Recommended for liquid or gas service on meter manifolds, seal chambers, hydraulic equipment and similar applications. Valve is supplied in five variations of globe and angle types, accommodating line pressures to 3000 psi. **Foxboro Co, Foxboro, Mass.**

Circle 306 on Reader Service Card

Strain relief is molded . . .

with groove around diameter to accommodate panel through which it is inserted. Separate metal C-ring is provided to lock strain relief in place. C-ring is said to permit more accurate positioning and to facilitate installation. When used with D-shape openings, strain relief prevents cord from being twisted. Suitable for use with wire sizes No. 18/2 SVT, No. 18/2 SPT-2, No. 18/2 SPT-1, 20 XT, TPT, 20 PLT and other special constructions. Can be color-matched. $30 to $40 per 1000 pieces. Delivery, 3 to 6 wk, depending upon application. **Phalo Plastic Corp, Shrewsbury, Mass.**

Circle 307 on Reader Service Card

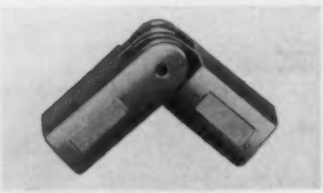
Solid-state ac time delay . . .

operates from 115 v ac, 60 or 400 cps. Fixed time delay, which occurs on pull-in, can be between 0.020 and 300 sec. Available with accuracy ratings of ±10% or ±5% of nominal time delay. Said to withstand temperatures from —67 to 257 F; vibration to 20 g, 2000 cps; shock to 50 g, 11 millisec; acceleration to 20 g. Solid-state timing module consists of RC timing network, resistance divider biasing

continued on page 96

network and gate circuit. Standard models include built-in control relay, 2PDT, 2 amp. **Tempo Instrument Inc, PO Box 338, Hicksville, NY.**

Circle 308 on Reader Service Card



Hinge is cast . . .

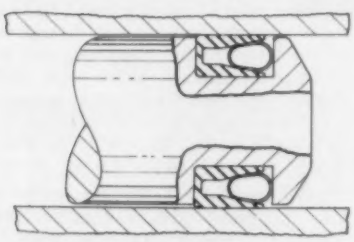
of aluminum so that it will allow any degree of slope from 0 to 90° on control panels or cabinet fronts. **Amco Engineering Co, 7333 W Ainslie St, Chicago.**

Circle 309 on Reader Service Card

Pump pulsations are reduced

to 1% or less of system pressure by device that acts as pulsation eliminator and noise trap for all classes of liquid pumps. Has no moving parts, contains no elastomer or flexible seals or members and is said to be compatible with all liquids. Available in unlimited flow ranges, working pressures to 25,000 psi and temperatures from —450 to 1000 F. **Auto-Control Laboratories Inc, 333 S Hindry, Inglewood, Calif.**

Circle 310 on Reader Service Card



Cryogenic dynamic seal . . .

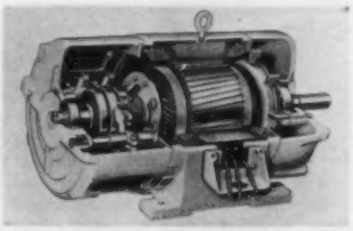
for use in O-ring grooves is said to prevent leakage at temperatures from —423 to 400 F in contact with liquid hydrogen, nitrogen or oxygen. Seals fit into external or internal O-ring grooves. Seal consists of Teflon seal ring and stainless steel ring, which is oval in cross-section and is wound at slanted angle to provide load required for sealing. Can be used in reciprocating or rotating applications and at pressures from vacuum to 20,000 psig. Sizes from $\frac{1}{16}$ to $2\frac{3}{4}$ in. dia are offered from stock. Seals also available for use in acids, fuels and very low friction. **Balsells Engineering Co, 9925½ S Greenleaf Ave, Santa Fe Springs, Calif.**

Circle 311 on Reader Service Card

Miniature magnetic clutch . . .

with min torque rating of 10 in.-oz at speeds to 1000 rpm is stocked in 6-, 12-, 28- and 90-v ranges; all operating at 2.5 w. Unit occupies about 1 cu in. Torque loss with stainless ballbearings is said to be less than 0.3 in.-oz. Field shaping and steel-to-brass clutch face is reported to enable clutch to deliver up to 15 in.-oz to the load at 2.5 w. Operates to 185 F and withstands severe humidity, shock and air pressure conditions. Overvoltage of 120% is permissible for 50% duty cycle. Clutch drives potentiometers, servo balance units, remote controls and speed changers. Price is $27.50 for 1 to 10 units. Small quantities from stock. **Ultronix Inc, 111 E 20th Ave, San Mateo, Calif.**

Circle 312 on Reader Service Card



Redesigned wound-rotor motors . . .

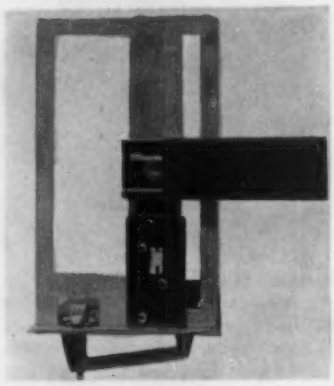
are said to meet NEMA standards in frame sizes 213 to 326 U. Size and weight have both been reduced, while cast iron housing and end-bracket construction with oversize grease reservoirs have been retained. Rotor end coils are banded with epoxy fiberglass to avoid end-coil shorts due to wire cutting insulation. Can be furnished with open, dripproof or totally enclosed, nonventilated enclosures for horizontal, ceiling or sidewall mounting. **Louis Allis Co, 427 E Stewart St, Milwaukee 1.**

Circle 313 on Reader Service Card

High-temp structural ceramic . . .

is said to be relatively low in cost, high in physical strength and resistance to attack by heat and molten salt. Though silicon nitride-bonded refractory was originally developed for refractory linings for aluminum reduction cells, it is suitable for such uses as melting and alloying high-purity, expensive metals; transferring molten materials; as structural ceramic for package boilers and incinerators, and as kiln furniture for ceramic industry. Material is not fully commercial in all applications. Price is reported to be lower than other commercially available nitride-bonded silicon carbide products with comparable properties and characteristics. **Norton Co, Worcester 6, Mass.**

Circle 314 on Reader Service Card



Rotating chassis slide . . .

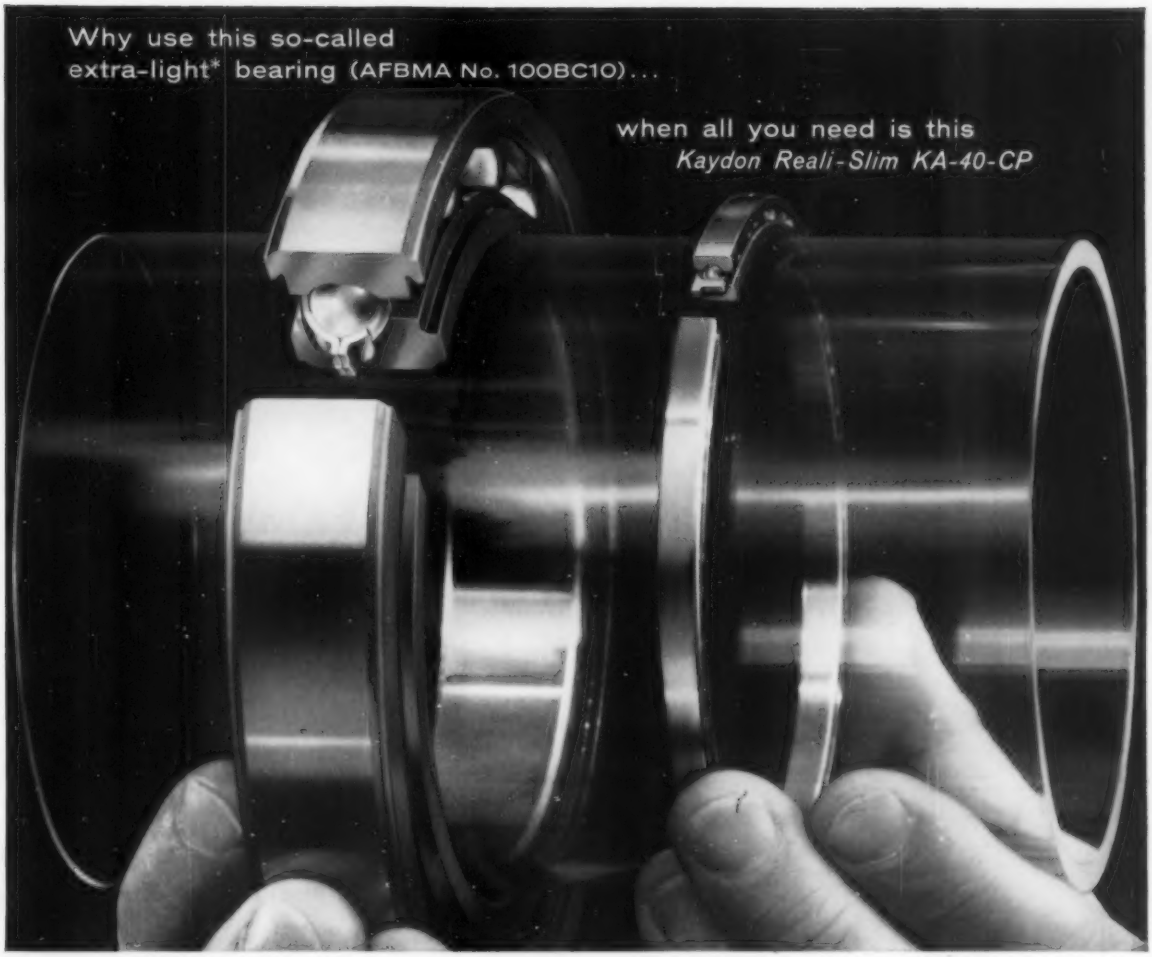
can be locked in horizontal position and 45° and 90° above and below horizontal. No space is said to be wasted between chassis section of slide and side frame of chassis. One of four models in chassis slide line, all of which have internal locking system permitting removal of electronic chassis by depressing release lever. All mount standard 17-in. chassis into $17\frac{3}{4}$-in. cabinet opening. Rated to carry over 200 lb in extended position. Units are permanently dry-lubricated. **Electro-Rack Inc, 11505 Jefferson Blvd, Culver City, Calif.**

Circle 315 on Reader Service Card

Pushbutton timer . . .

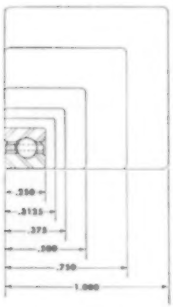
provides automatic shutoff and reset and 0.0025 repeat accuracy. Available in 16 standard dial ranges from 6 sec to 60 hr for ac or dc operation. To operate, pointer is set at desired time interval on dial and pushbutton is pressed. This engages metal-to-neoprene impingement clutch and starts motor. Another pointer indicates

continued on page 99



News from Kaydon!

Reali-Slim bearings "off the shelf" ...prices slashed up to 76%



*Five of the six series of Type "CP" Reali-Slim bearings are smaller in cross section than the AFBMA standard "extra-light" series bearing shown above.

Up to 85% lighter, up to 70% narrower than the lightest of the "extra-lights"

More than 80% of all present standard "extra-light" series bearing installations never require the full capacity of the bearing.

Kaydon now trims this expensive bearing excess! Kaydon Type "CP" Reali-Slim bearings match proper size, weight and capacity to specified shaft sizes. Overcapacity need no longer hamstring your product designs.

Here's why! In Kaydon's new Type "CP" Reali-Slim bearings (world's thinnest), width and cross section *remain the same* for all bearing sizes in any one series.

Example: each of the 15 sizes from 4" to 12" bore in the Reali-Slim KA series has only ¼" width and cross section. Result: new opportunity to save on cost, size, and weight . . . in bearings and adjacent components.

Availability? Now off-the-shelf in 90 sizes with Conrad deep-groove, ball-radial construction . . . and new bronze one-piece snap-over separator in 4" to 12" bore — ¼" to 1" width and cross section. Kaydon's volume production cuts prices as much as 76%, depending on size. Write for free, fact-filled "CP" bearing bulletin — with prices!

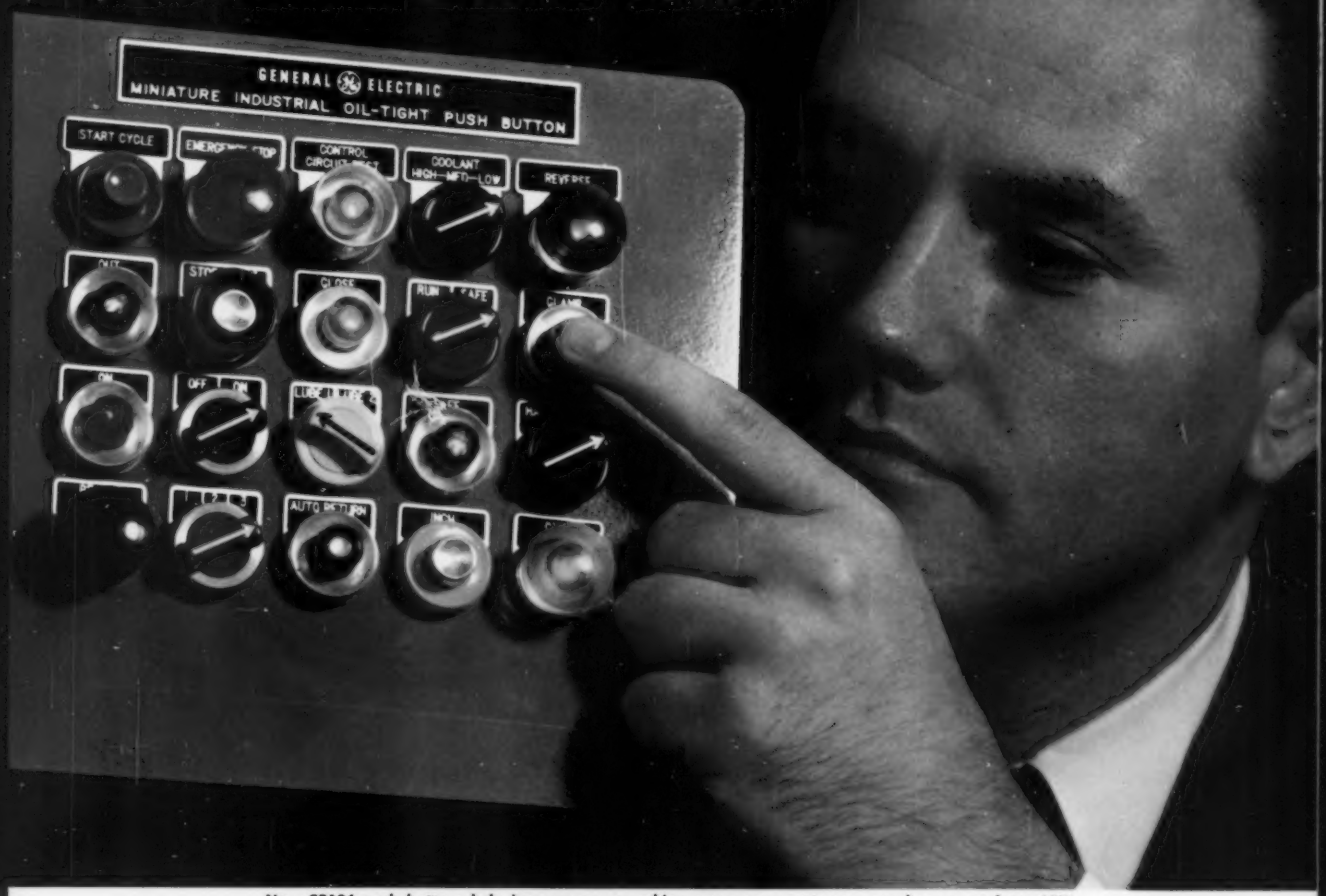
THE KAYDON ENGINEERING CORP.
MUSKEGON • MICHIGAN

All types of ball and roller bearings — 4" inside diameter to 178" outside diameter . . . Taper Roller Roller Thrust • Roller Radial • Needle Roller • Ball Radial • Ball Thrust • Four-Point Contact Bearings

K-160

New

Another Measurable Advantage from General Electric Control



New CR104 push buttons help improve your machine appearance, cut your panel space at least 40%.

FIRST COMPLETE LINE OF INDUSTRIAL MINIATURE OIL-TIGHT PUSH BUTTONS

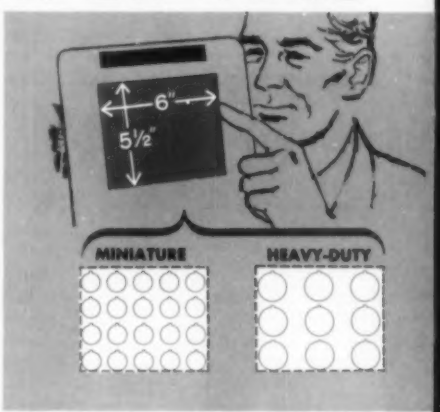
• Push buttons • Selector switches
• Illuminated push buttons • Indicating lights
• Push-to-test lights

Now you can design entire panels with miniature pushbutton units and cut your panel space requirements at least 40 per cent! General Electric announces the development and immediate availability of industry's first complete Industrial Miniature Oil-tight Pushbutton line.

This new CR104 line offers you the operating and functional units presently available in heavy-duty oil-tight forms —with an attractive appearance that enhances the design of your machines. A wide variety of operators is available, plus various modifications, special units, and nameplates to meet every operating requirement. Color coding is available in *both* operators and rings to provide you the flexibility of many different color combinations. Also, enclosures and pendent stations are available to accommodate from four to 42 units.

FOR MORE INFORMATION on this outstanding new development in control—and the "measurable advantages" it offers you—contact your nearby G-E Apparatus Sales Office, or write for Bulletin GEA-7127, General Electric Co., Schenectady 5, N. Y. 811-10

You get
MEASURABLE ADVANTAGES
WITH GENERAL ELECTRIC CONTROL



SAVE PANEL SPACE. Twenty new General Electric miniature units fit into the *exact* space required for nine heavy-duty oil-tight push buttons.

GENERAL ELECTRIC

Going to the ...
MACHINE TOOL EXPOSITION?

You Can See ...
THE COMPLETE NEW LINE OF GENERAL ELECTRIC INDUSTRIAL MINIATURE OIL-TIGHT PUSH BUTTONS ACTUALLY INSTALLED ON MACHINES

GENERAL ELECTRIC BOOTH—You can get complete information on the new G-E CR104 line of Industrial Miniature Oil-tight Push Buttons by visiting General Electric Booth #112 at the Production Engineering Show, Chicago's Navy Pier, Sept. 6–16.

SEE INSTALLED UNITS HERE—Also, no less than 28 of the machine tool industry's leading manufacturers are exhibiting new machines which feature these General Electric industrial miniature oil-tight units at their booths in the Chicago Amphitheatre. They include:

Atlantic Machine Works, Booth 543
Avey Drilling, Div. of Motch & Merryweather, Booth 822
Barber-Colman, Booth 923
Buffalo Forge Company, Booth 551

Chas. G. Allen Co., Booth 148
Cincinnati Milling Machine Co., Booth 1034
Clearoman Machine Tool Corp., Booth 632
Cone Automatic Machine Co., Booth 1215
Dennison Engineering Division, American Brake Shoe, Booth 914

DeVlieg Machine Co., Booth 431
Edlund Machinery Co., Div. Harsco Corp., Booth 531
Ekstrom Carlson and Co., Booth 846
Fellows Gear Shaper Co., Booth 929

Fosdick Machine Tool Co., Booth 800
Gardner Machine Co., Booth 811
Giddings and Lewis, Booth 1320
Giddings and Lewis/Bickford, Booth 1320
Heald Machine, Booth 924

Lucas Machine, Div. of New Britain Machine Co., Booth 838
Kearney & Trecker, Booth 1008
R. K. Le Blond, Booth 810 and 908
Michigan Tool Co., Booth 945

Nebel Machine Tool Corp., Booth 1319
Niagara Machine Tool Works, Booth 1330
Rivett Lathe & Grinder, Booth 1210
Sidney Machine Tool Co., Booth 1440
Sundstrand, Booth 1014
Warner and Swasey, Booth 451

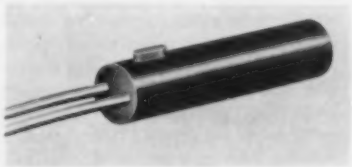
Before you leave the show make sure you've seen industry's first complete line of industrial miniature oil-tight units. Your General Electric sales engineer will be glad to provide you with more information. Contact him or write General Electric Co., Section 811-11, Schenectady, N. Y.

Progress Is Our Most Important Product
GENERAL ELECTRIC

CIRCLE 99 ON READER SERVICE CARD

timing progress and when pointer reaches zero on dial, load switch (or switches) is actuated and also returns automatically to original position. Clutch then disengages, motor is deenergized and timer automatically resets. **Automatic Timing & Controls Inc, King of Prussia, Penna.**

Circle 316 on Reader Service Card



Low-cost, 2-amp mercury switch . . .

is said to be shockproof, waterproof and to operate on any axis. Switch and leads are potted in rigid PVC. Nominal diameter of switch is 0.5 in.; nominal length, 1 11/16 in. Price is 50¢ each in OEM quantities. **Gordos Corp, 250 Glenwood Ave, Bloomfield, NJ.**

Circle 317 on Reader Service Card

Industrial pushbutton stations

and control units are available in three types. Included in each of the pushbutton lines are pushbutton units, selector-switch units, standard pilot lights, and push-to-test pilot lights or lighted pushbuttons. Operators of pushbuttons are available guarded, unguarded, ⅜ in. long and 1½ and 2¼ in. palm buttons in seven colors. Electrical control units include oiltight and general-purpose, NEMA 1, units for panel or base mounting. Entire series is said to meet NEMA standards for industrial use. **Clark Controller Co, 1146 E 152nd St, Cleveland 10.**

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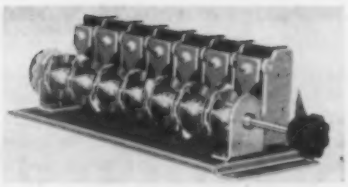

12-position selector switch . . .

for program changes offers 1 to 20 load circuits as standard. Each circuit has 10-amp contact rating. Circuit adjustment is accomplished by inserting removable cam segments in 1 to 12 available locations. Each unit has dial and position indicator. Position control is spring-loaded. Load switches are adjusted to operate without actuator overtravel, said to extend switch life. **Industrial Timer Corp, 1407 McCarter Highway, Newark 4, NJ.**

Circle 319 on Reader Service Card

Proximity transducer . . .

senses both nonferrous and ferrous metal parts. Complete installations, including sensing and control units, start at $84, list. Installations consist of a pickup at point of work and control unit. Any metal workpiece can activate pickup without physical contact. Unit can be housed in any wiring enclosure measuring 6 x 8 x 4 in. or larger. Sensitivity control permits adjustment to desired operating range. Capable of max operating rate of 600 operations per min. Responds to metal parts that remain within range of pickup for 50 millisec or more. Input is 117 v, 50/60 cps, ac at 15 w; 240 v optional. Output consists of SPDT relay, contacts rated 5 amp noninductive. **Electro Products Laboratories Inc, 4500 N Ravenswood Ave, Chicago 40.**

Circle 320 on Reader Service Card

Electromagnetic speed changer

has self-contained magnetic clutch. Input shaft is concentric to 0.0015 in. with output shaft. Clutch offers speed ratio of 1:1 when energized (transmitting 70 in.-oz min at output shaft) and 9:1 step down when deenergized (transmitting 30 in.-oz min). Output shaft rotates in same direction in both positions. In either position, max torque transmitted is limited to 85 in.-

continued on page 100

oz by built-in slip-clutch. Total backlash is 30 min. max. Unit, which is said to meet all applicable portions of MIL-E-5272A, operates on 115 v dc at 5 w. Min operating life is 1000 hr. Can be supplied in smaller sizes than standard BuOrd 18 by incorporating size 11, 8 or 5 clutches and proportionately smaller gearing. **Orbit Instrument Corp, 131 Eileen Way, Syosset, NY.**

Circle 321 on Reader Service Card

Miniature fixed delay timer . . .

is solid-state unit with range of 25 millisec to 1 min. and can be supplied adjustable on request. Timer is temperature-compensated with accuracy said to be ±5% over temperature range of —67 to 176 F. Input voltage is 18 to 30 v dc. Acceleration is 20 g for 1 min. Reported to be fungus- and moisture-proof and to operate in any position. Min life is 100,000 cycles. Measures 1 cu in. Weighs 1.4 oz. **Elgin Micronics, Chatsworth, Calif.**

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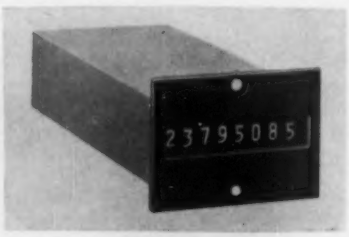

Totalizing electric counters . . .

are offered in seven-and eight-digit units, both with same dimensions, 1.653 x 1.220 x 4.370 in. Available in counting speeds of 25 impulses per sec and 10 impulses per sec. Power requirements are 1.6 w at 24 v dc for 10 impulses per sec units. Suitable for flush mounting. Furnished without reset. **Landis & Gyr Inc, 45 W 45th St, New York 36.**

Circle 323 on Reader Service Card

4PDT, 10-amp relay . . .

is offered in two contact configurations, with heavy-duty contacts rated to 10 amp resistive at 28 v dc or 110 v ac and with lighter weight 5-amp contacts. Either type is available in various mounting styles. Life span is reported to be better than 300,000 operations at rated load, ambient temperatures; 100,000 operations or more at 275 F to Mil-R-5757C. Designed for operation between —85 and 257 F. Rated to 25 amp min overload, with max coil dissipation of 6 w. Operate and release time is 7 millisec max. **Babcock Relays Inc, 1640 Babcock Ave, Costa Mesa, Calif.**

Circle 324 on Reader Service Card

Nine-speed transmission . . .

for extremely heavy-duty off-highway and industrial applications offers nine closely spaced forward gear ratios (9.24 to 0.69) selected with singleshift lever. Features pressurized jet-spray lubrication for operating gear teeth, pressurized lubrication for mainshaft pilot bearing of front section as well as bushing of mainshaft-mounted gears, countershaft inertia brake that makes quick upshifts possible without double clutching, and an inhibitor that prevents operator from engaging gears in front section until automatic shift in auxiliary is completed. Two power takeoff openings are provided, one on each side of transmission. On right side, heavy-duty type provides drive gear speeds of 0.74 engine speed, while regular-duty type on left side provides drive gear speeds of 0.60 engine speed. **Fuller Mfg Co, Transmission Div, Kalamazoo, Mich.**

Circle 325 on Reader Service Card

Conductive plastic potentiometer . . .

is reported to operate in excess of 25 million cycles. Linear motion, infinite-resolution unit is in case about 1¾ in. long. Stainless steel shaft is supported on bronze bushings at each end. Standard unit is supplied with Teflon-insulated leads coded for identification. **New England Instrument Co Inc, 1334 Main St, Waltham, Mass.**

Circle 326 on Reader Service Card

Material-level control . . .

can determine presence or absence of material at desired level in bin, hopper, storage tank or similar container. Especially suited for use with powdery or granular products. Rotating paddle in container controls generation of small signal. Transistor circuit amplifies signal and operates electrical contacts to control equipment or operate indicators. Control contacts are rated 2 amp at 110 v ac or 1 amp at 220 v ac. If any portion of instrument fails, control contacts operate automatically, as if predetermined level had been reached. Instrument mounts on 1¼ in. pipe coupling. **Electronics Controls Div, Flo-Tronics Inc, 1420 Zarthan Ave, Minneapolis 16.**

Circle 327 on Reader Service Card

Converter-transmission packages . . .

consist of single-stage torque converter, standard mechanical transmission and standard mechanical spring-loaded clutch. Provides automatic torque multiplication in all gear ratios so that sudden load increases can be handled without shifting gears. Available with choice of transmission. Lipe or Spicer spring-loaded clutches can be specified. Capacity range is up to 300 hp and up to 650 ft-lb torque. **Twin Disc Clutch Co, Racine, Wis.**

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Shaft-position encoder . . .

provides 360 discrete counts per rotation of input shaft. Numerical indication of shaft position is in degrees in 8-4-2-1 binary-coded-decimal code. Incorporates self-selecting V-brush logic and does not require extensive external brush-selection logic circuitry to accomplish its function. Encoder is packaged in size 33 standard BuOrd synchro mount. **Norden Div, United Aircraft Corp, Wiley St, Milford, Conn.**

Circle 329 on Reader Service Card

Plastic film for nameplates . . .

and emblems is produced in metallic chrome or gold and variety of basic colors. Any message can be silk-screened or printed on film, which is held in place by pressure-sensitive adhesive. Premasked versions of film permit application of nameplates directly to base or prime-coated surface before final painting of product. After final painting, masking is removed and nameplate is edge-sealed. **Minnesota Mining & Mfg Co, 900 Bush Ave, St Paul 6.**

Circle 330 on Reader Service Card

Wash-off polyester film . . .

produces erasable ink-black lines from pencil originals and permits ink or pencil-drawn additions. Lines are said not to smudge, yet are easily removed with soft, moist eraser. Film has high transparency for reproduction and long shelf-life expectancy without loss of wash-off characteristics. **Keuffel & Esser Co, Third & Adams Sts, Hoboken, NJ.**

Circle 331 on Reader Service Card

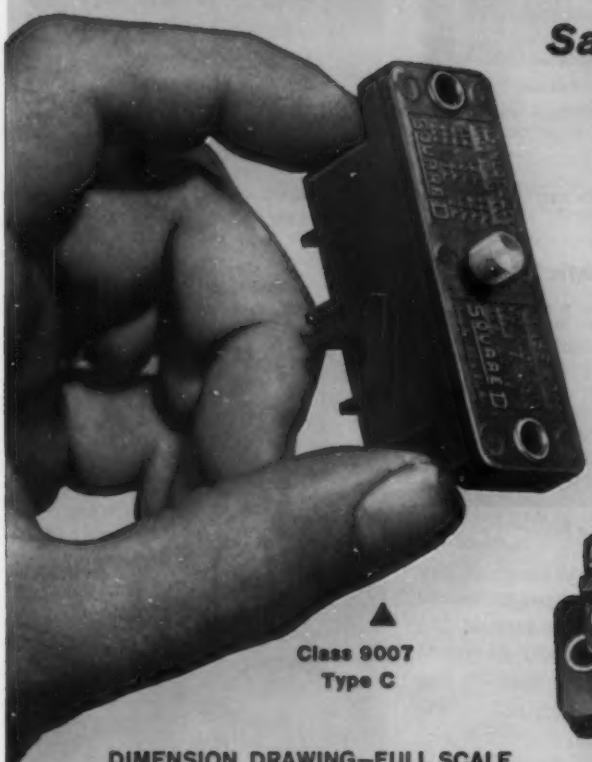
Compact drafting machine . . .

has 20-in. arms yet covers 34 x 44 in. drawing areas. Automatic indexing provides positive settings at 15-degree intervals or free rotation for setting at inter-

continued on page 102

Now!..

SQUARE D PRECISION *SNAP* SWITCH AVAILABLE WITH 2 POLES!



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The new switch is available either single-throw (2 normally open or 2 normally closed) or double-throw, and like the single-pole switch, it features: double-break contacts—large screw-type terminals—strong melamine case—simplified mounting...a design which assures reliability, precise repeat accuracy and long mechanical life.

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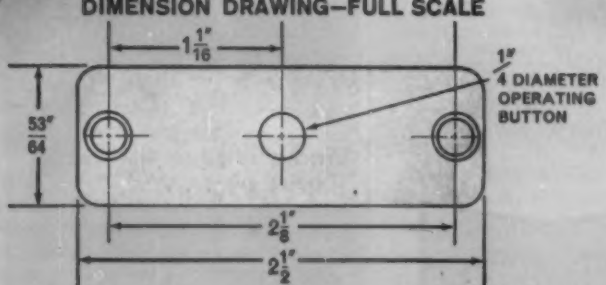

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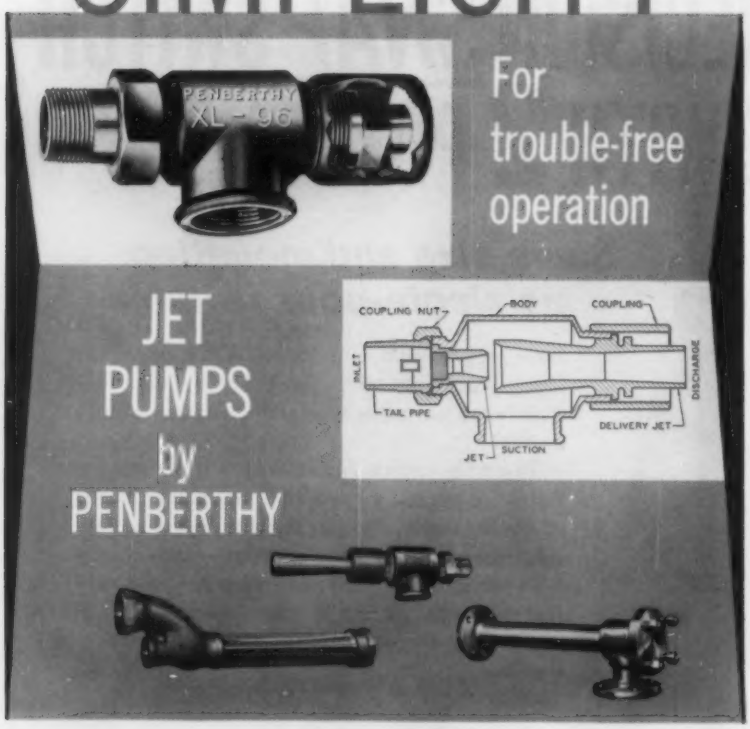

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mediate angles. Disk brakes maintain position on moderately inclined drawing board. Ball joints within elbow brackets permit lifting of head and scales over objects on board. Available with 9-, 12-, or 18-in. drafting-machine scales, but machine will accept any type drafting-machine scale with standard chuck plates. Elbow is reversible for operation to right or left. List price, $71. **V & E Mfg Co, Dept NR, 766 S Fair Oaks Ave, Pasadena, Calif.**

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10-milliv fixed-span recorder

records dc voltage or current variations versus time. Can measure any physical quantity that can be transduced into voltage or current within its range span. Offers balance time of ½ sec; accuracy of ½% of span limit of error; sensitivity of ¼% of span. Employs 5-in.-wide chart and is chopper-stabilized to eliminate zero-drift problems. Hum suppressor is said to minimize stray 60-cps pickup. Unit has floating high-impedance input with separate chassis ground. Utilizes positive pen drive and transparent plastic pen. Available with chart speeds of 16, 12, 8, 4, 2 and 1 in. per min.; 48, 40, 30, 24, 16, 4, 2 and 1 in. per hr. Price is $320, with one chart speed. **Nesco Instruments Inc, 638 W 17th St, Costa Mesa, Calif.**

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Transistor-equipped instrument . . .

to measure wall thickness between 0.025 and 2.50 in. is battery-operated. Portable ultrasonic unit gives direct reading by placing transducer on surface to be measured and turning dial. Housed in impact-resistant plastic case, 8¼ x 9¼ x 11¼ in. Separate carrying case for batteries is equipped with shoulder straps for use outdoors. Accuracy is said to be 1% when calibration is checked during tests against known sample of the same material. Unit weighs 12¼ lb. Price, $1280. Delivery, 4 wk. **Magnaflux Corp, sub of General Mills, 7300 W Lawrence Ave, Chicago 31.**

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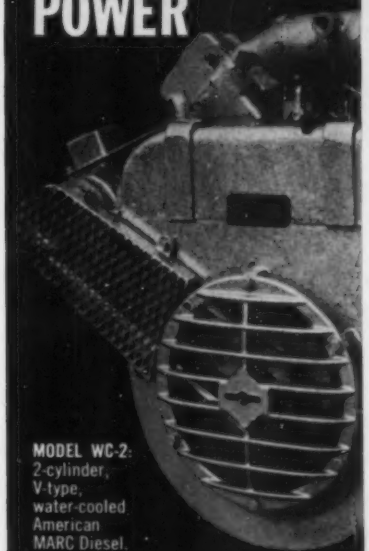
FROM EVERY ANGLE... DEPENDABLE POWER



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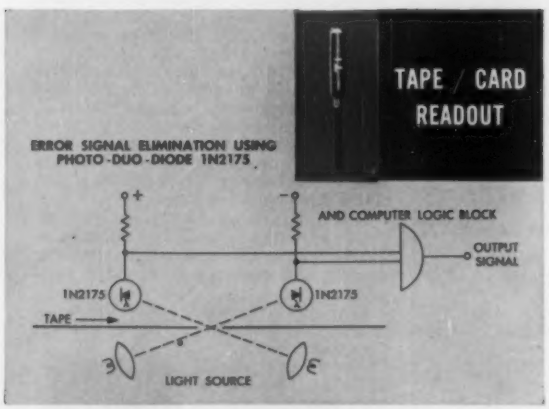
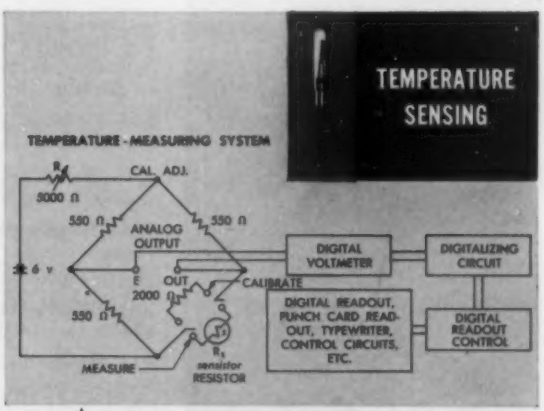


TI 1N2175 photo-duo-diodes Four times more sensitive than any other commercially available photosensitive unit, the new TI PHOTO-DUO-DIODE is ideal for your industrial control tape readout, inspection, counting, switching, interlocking, and over-load protection applications. This new light sensing device passes up to 1200 microamps when exposed to 1200 foot-candles of light and less than 0.5 microamps in darkness. Rated at 250 milliwatts dissipation at 25°C, the TI 1N2175 will operate equally well on either alternating or direct current and any biasing voltage up to 50 volts.



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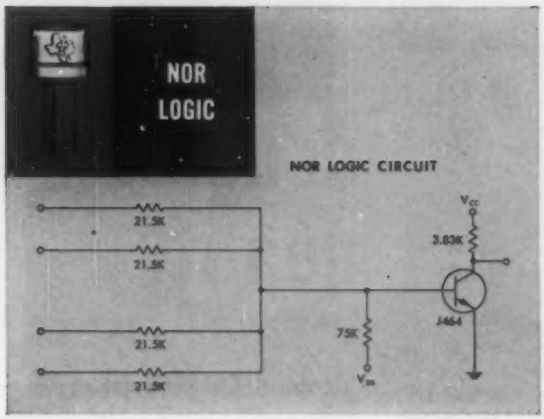

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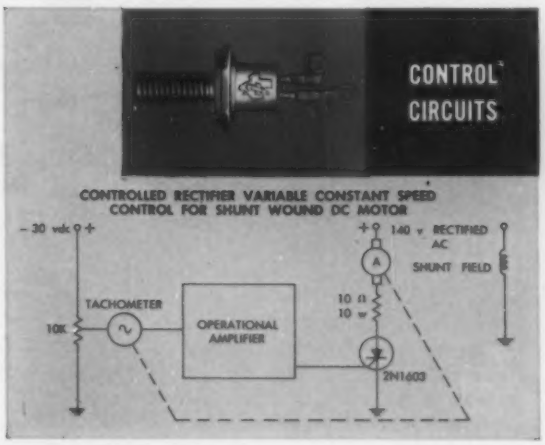

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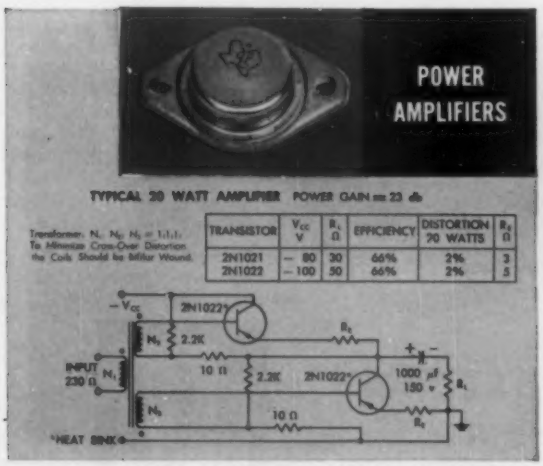
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DESIGN LITERATURE

Zetetics—Research as a Science

JOSEPH T TYKOCINER. Printed by Electrical Engineering Laboratory, Univ of Illinois, and distributed by Joseph T Tykociner, 306 W Iowa St, Urbana, Ill. 8½ x 11, paperbound, 205 pp. $2.

Through research we have learned a great deal about science—but what about research itself? Considering the number of years man has been at it, we should have collected a great deal of information about the methods of research—enough information and enough unanswered questions to compose a scientific discipline of its own. This, at least, is the opinion of Prof Tykociner, researcher, inventor and Professor Emeritus of the University of Illinois. His book is a one-man effort to lay the groundwork for this new science.

The physicist studying atomic forces, the biologist studying the character of brain waves, the economist studying business cycles, use similar methods to solve their problems. Call it the Scientific Method if you like, but the interrelationships among the disciplines go deeper than that. Call it Zetetics (from the Greek verb zeteto, "to investigate") proposes Professor Tykociner. He defines his new science as "the totality of recorded, systematized knowledge related to such methods of research, mental processes, psychological factors, and environmental conditions as lead to new problems, stimulate creative imagination, enhance selective thinking and generate original, fruitful ideas." A large order, perhaps, but one he believes worthy of man's further inquiry.

The idea is one he has been tinkering with since 1926. It was then that he recognized the haphazard ways of research: the growing trend toward group research rather than individual activity; the haste in introducing innovations before the scientific facts are clearly understood; the element of chance in the decision to choose what problems shall be researched. "What a grand thing it would be," he reflected, "if it were possible to set up a scheme which would do for all sciences what the periodic table has done for physics and chemistry. If such a scheme could disclose glaring gaps in our knowledge, would it not lead us toward new discoveries and inventions?" His book is a compilation of notes collected since that time and in this preliminary form consists of only the first two parts of a planned four-part work.

The major part, Part I, defines the new science and suggests the scope of its activities. Part II is a list of all branches and sub-branches of science cataloged under 12 major headings.

Though the idea of research as a science seems to impose a rigor on a system that works quite well without it, Professor Tykociner's proposal is reasonable, though in its present form only roughly developed. Some may object to the mock-scientific terms coined by the author, but few will find fault with his objective of furthering our knowledge in all branches of science by improving our methods of investigation. —CJL

Statistical Evaluation of Fatigue and Creep-rupture

WALODDI WEIBULL. (OTS 161297) WADC Technical Report 59-400. Office of Technical Services, Dept of Commerce, Washington 25, DC. 8½ x 11. $2.

Fatigue testing normally requires a large number of tests because of the large scatter. But the number of these expensive tests can be reduced 30% or more by simply using efficient statistical methods to evaluate test data. Usually this does not increase the cost of computing average values; but even if it does, it still can save money. (Cost of competely testing one fatigue specimen is equal to cost of 15 minutes on an electronic digital computer of the Swedish BESK type).

Other Books of Interest

Mechanical Press Handbook

Metalworking Magazine, 221 Columbus Ave, Boston. 6 x 9¼, 256 pp. $5.

Discusses presses and accessories for this type of machinery that are available, together with their application to metalworking.

Encyclopedic Dictionary of Electronics and Nuclear Engineering.

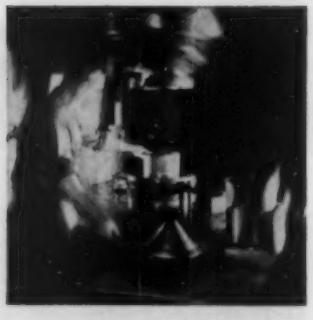
R I Sarbacher. Prentice-Hall Inc, 70 Fifth Ave, New York 11. 7 x 10¼, 1417 pp. $35.

Coordinate Geometry

L P Eisenhart. Dover Publications Inc, 180 Varick St, New York 14. 5¼ x 8, 298 pp. $1.65.

Unaltered paperback edition of a text first published in 1939.

continued on page 109



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J&L consistent quality stainless steel is as near as your telephone . . .

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Western Union Operator 25 will give you the name of your nearest J&L stainless steel distributor. You'll find that he can further reduce your costs of using stainless steel by providing a complete selection of materials. He can save you the capital investment required to maintain long term inventories. He can provide a wide variety of preproduction services, and reduce your overhead for stocking, handling, accounting and obsolescence.

Your J&L distributor can provide you with the consistent quality stainless steel you need, *as you need it, when you need it*. He can serve you better because *J&L serves him better*. J&L's own staff of technical specialists and metallurgists are at the call of your J&L distributor to give you the technical assistance, even advanced research, you may need.

For better production and better service, call your J&L distributor—call Western Union Operator 25, today.

J&L—a leading producer of stainless steel and precision cold rolled strip steels.

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SHEET • STRIP • BAR • WIRE

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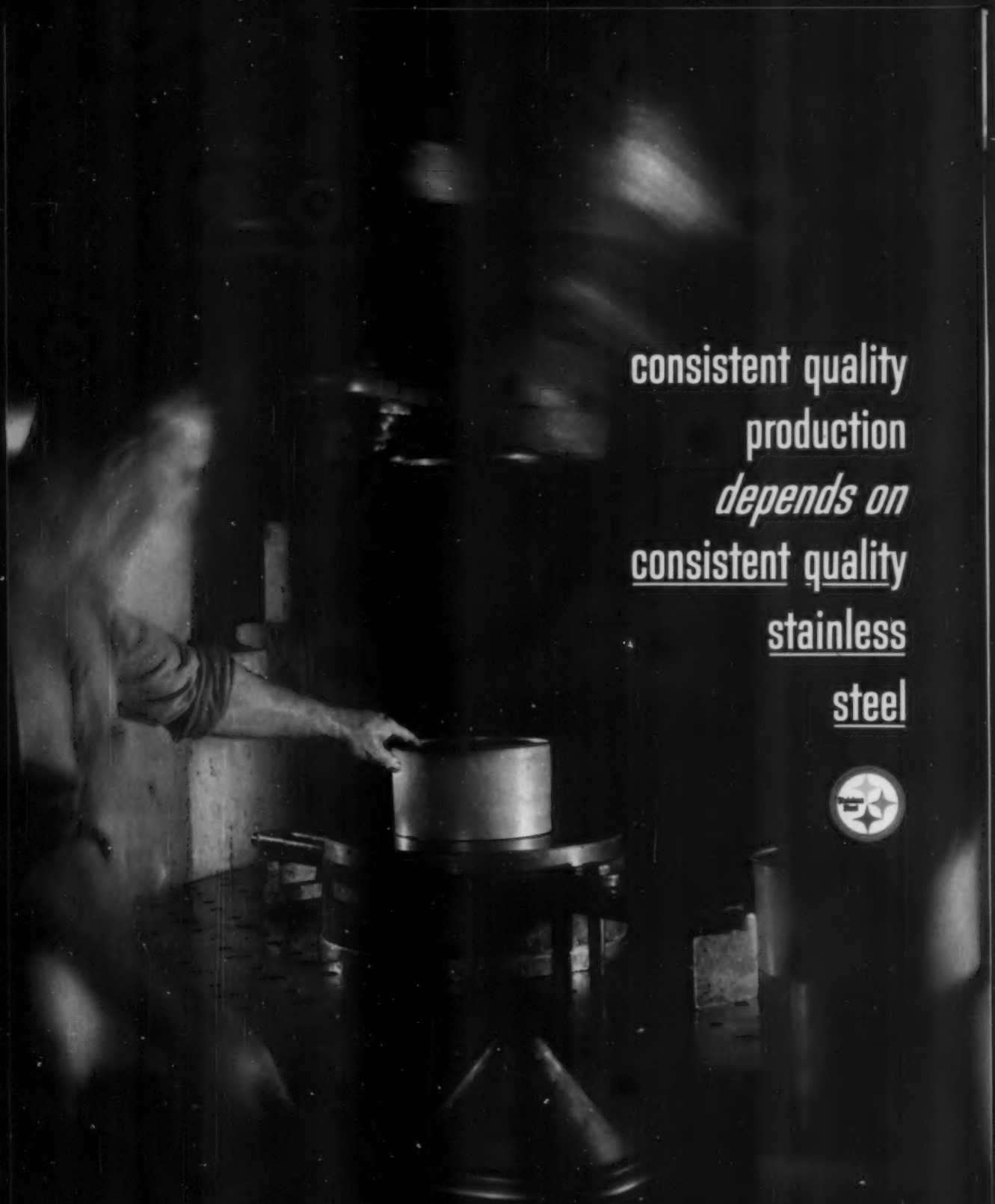

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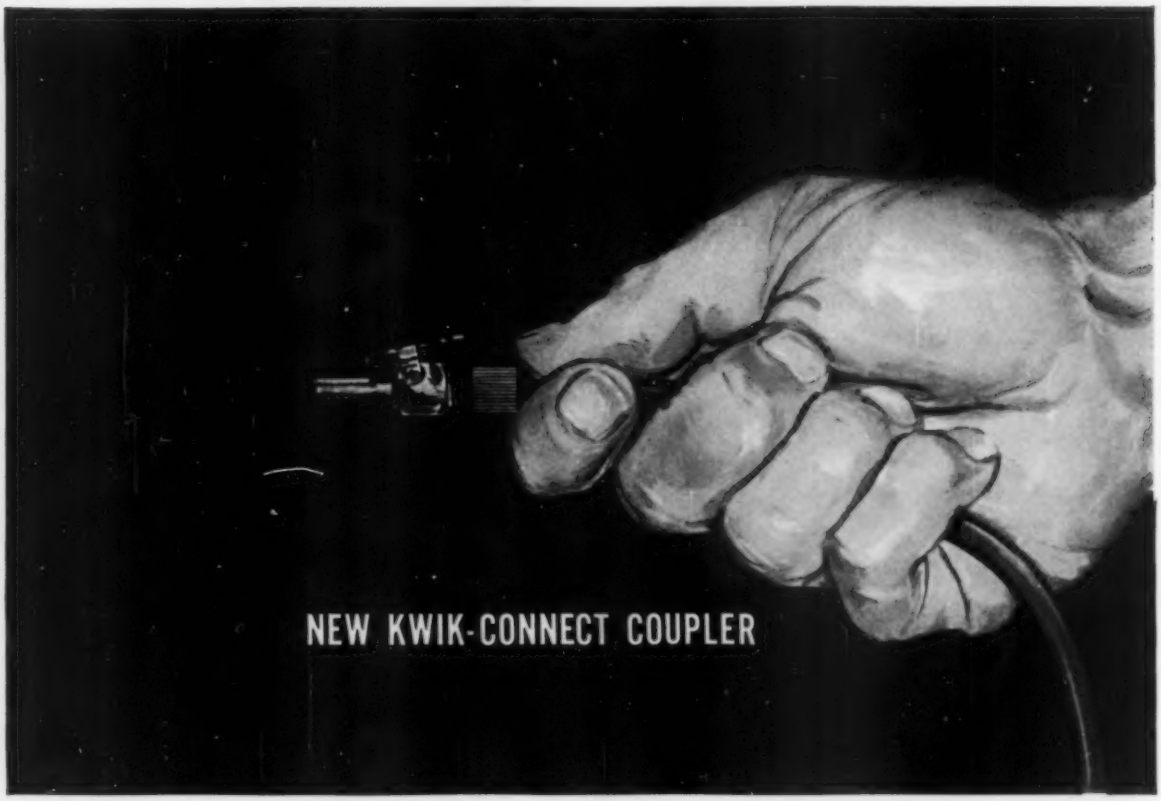


PUSH...IT CONNECTS! *CLICK*...IT DISCONNECTS!

Making instrumentation connections with this new, polished-chrome Kwik-Connect Coupler is simple and fast. No pushing and fumbling with special rings or clamps. No complicated mechanisms. It's a snap!

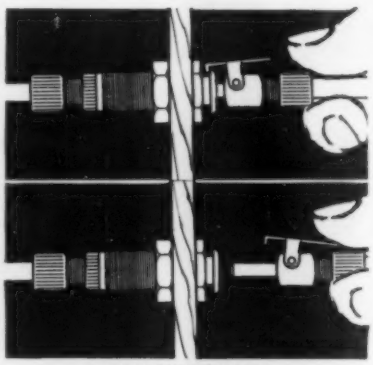
Just plug the parts together with a slight hand pressure. A unique cam action automatically moves the clip and locks the coupling in position. Inside, the flow is unrestricted through both the tube and coupling.

To uncouple, you simply press the spring-loaded clip. This disconnects the coupling and instantly seals off the flow. The patented shut-off feature is available in either the body end or the male connector end.

Other patented design features and the use of an "O" ring seal make Imperial's new Kwik-Connect Coupler a completely dependable connection far beyond the burst strength of polyethylene tubing.

LESS BULK, LESS WEIGHT

Only two moving parts — far simpler in design than ordinary quick couplers.



PROBLEM SOLVER

Kwik-Connect makes systems checking faster, easier. Ideal for pull-out consoles, test stands, panel boards, manifolding — eliminates the need for multiple gauges. Mounts on panels up to 1" thick.

Less bulky, lighter in weight. The ⅜" O.D. coupling weighs less than 3½ ounces; the ¼" O.D. coupling, less than 2 ounces. More dependable, too, because of a positive safety lock. It's the only quick-connect coupling that provides visual proof of a positive connection.

Kwik-Connect Couplers are available two ways: tube-to-tube or tube-to-pipe thread. Tubing connections are Imperial Poly-Flo fittings which need only be finger-tightened, providing easier assembly, faster installation of polyethylene or other plastic tubing. Universal sleeve and nut available for nylon and metal tubing. Couplers fit bulkheads up to 1" thick.

WRITE TODAY for Bulletin 3119 giving complete information.

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Chicago 48, Illinois

Development of High-strength Steels by Working of Metastable Austenite

PB 161189. F R Morral. Defense Metals Information Center, Battelle Memorial Institute, Columbus 1, Ohio. Available from Office of Technical Services, Dept of Commerce, Washington DC. 8½ x 11, 20 pp. 50¢.

CORRECTION

In a review of "Mechanisms: Analysis and Design", by Hill and Rule, and published by Allyn and Bacon Inc, 150 Tremont St, Boston 11, the number of pages and the price given were incorrect. The correct price of this 86-pp book is $4.95.

ABSTRACTS FROM THE LITERATURE

Identifying Plastics

Large variety of plastic materials and constant stream of new additions has made problem of identifying them more complicated. Feel, smell, appearance and burn tests are no longer enough. This article provides foldout chart that gives detailed, step-by-step chemical-analysis procedures. An additional table of procedures is included for those materials requiring analytical steps beyond those given in basic flow chart.

"What Plastic Is It?" Gruben and Leiner, Resin Research Laboratories Inc. Modern Plastics, July '60, 575 Madison Ave, New York 22.

The Engineer and the Law

Describes several precedent-making legal cases that can seriously affect the practicing engineer, particularly if he is licensed.

"The Engineer and the Law," Irwin L. Tunis, P E and attorney-at-law. Mechanical Engineering, July '60, 29 W 39th St, New York 18.

Contact Time Between Spur-gear Teeth

Contact time between mating gear teeth was studied because of its significance in the study of stress gradients in high-speed gears and also because of its effects on lubrication processes and materials. In this study, definition of contact time is based on half-width of band of contact. Contact areas for five phases of contact are discussed: first point of contact; first point where single pair of teeth takes all of load;

continued on page 112

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AND SHOCK

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The Isomode Type 5 Mount isolates equally the six possible modes of vibratory motion. With core in balanced compression and shear, it offers high load capacity and endurance in compact size. It is safely self-snubbing to control damaging overloads. And it can take an extraordinary amount of punishment.

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MB has specialized in vibration isolation for over 20 years. It may very well be that an existing standard MB mount or modification thereof is the answer to your vibration control problem. If not, MB has the experience and personnel to find the right answer for you. Write us for complete information—ask for Bulletin 418-1.

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A DIVISION OF TEXTRON ELECTRONICS, INC.
1076 State Street, New Haven 11, Conn.

Design of variable volume

AXIAL PISTON HYDRAULIC PUMPS

for systems up to 5000 psi

By: Ellis H. Born
Director of Sales-Engineering
Denison Engineering Division
American Brake Shoe Co.

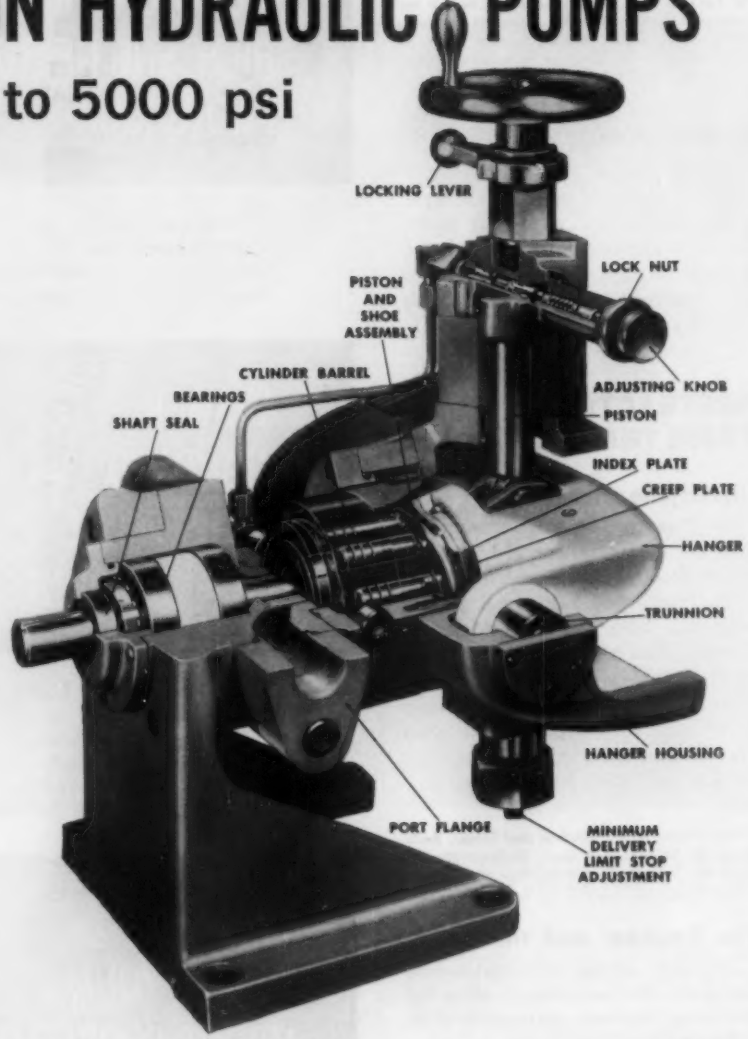
For 5000 psi requirements, the axial piston pump (illustrated) is a logical choice. It operates on the principle of a series of pistons in a common barrel that progressively draw oil into the barrel on the suction stroke and force oil from the barrel into the line on the discharge stroke.

With this simple axial piston design, direct and unrestricted flow into the pumping assembly is possible, eliminating the need for the large flow areas used and the moving seals which, in turn, eliminates maintenance. Direct flow path further insures good suction characteristics—a highly desirable operating advantage for obtaining efficient hydraulic performance.

The port plate of the Denison pump is designed as an axial hydrostatic bearing which balances out the thrust of the cylinder barrel, leaving only sufficient force to create a positive seal contact between the cylinder port plate and the cylinder barrel. Because of reduced thrust, wear on mating surfaces is decreased and pump life is greatly extended at all pressures up to 5000 psi.

Where variable volume is required, it is logically desirable (for efficiency, simplicity and low maintenance) to eliminate the need for varying the position or angle of the cylinder barrel to regulate volume. In the Denison axial piston pump, output is simply regulated by varying cam plate angle. Zero to full flow or flow reversal is regulated by handwheel, hydraulic cylinder, stem, electric motor, compensator or electrohydraulically.

In the Denison design, the line of action of the combined radial load of all pistons is through the roller bearing supporting the cylinder barrel. The use of a large bearing provides non-deflecting support for these radial forces. As a result, unbalanced or twisting offset that would tend to unseat the cylinder barrel from the port plate is eliminated. A continuous, effective sealing action of the barrel against the port plate is maintained to promote high pumping efficiency.



Piston and shoe assembly design also reduces by one-half the number of ball and socket couplings found in other types of axial piston pump construction. The shoes hydraulically balance out all piston thrust, eliminating need for thrust bearings.

Data and specifications on 5000 psi pumps, motors and controls are available from your Denison representative—located in principal cities—to assist you in developing hydraulic systems for maximum efficiency and economy.

NEW CATALOG FOR DESIGNERS AND ENGINEERS

Write for your copy of Bulletin 220—"Hydraulic power to 5000 psi". Includes complete specifications, operating data and applications for Denison's full line of hydraulic pumps, motors and controls.

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American Brake Shoe Co.
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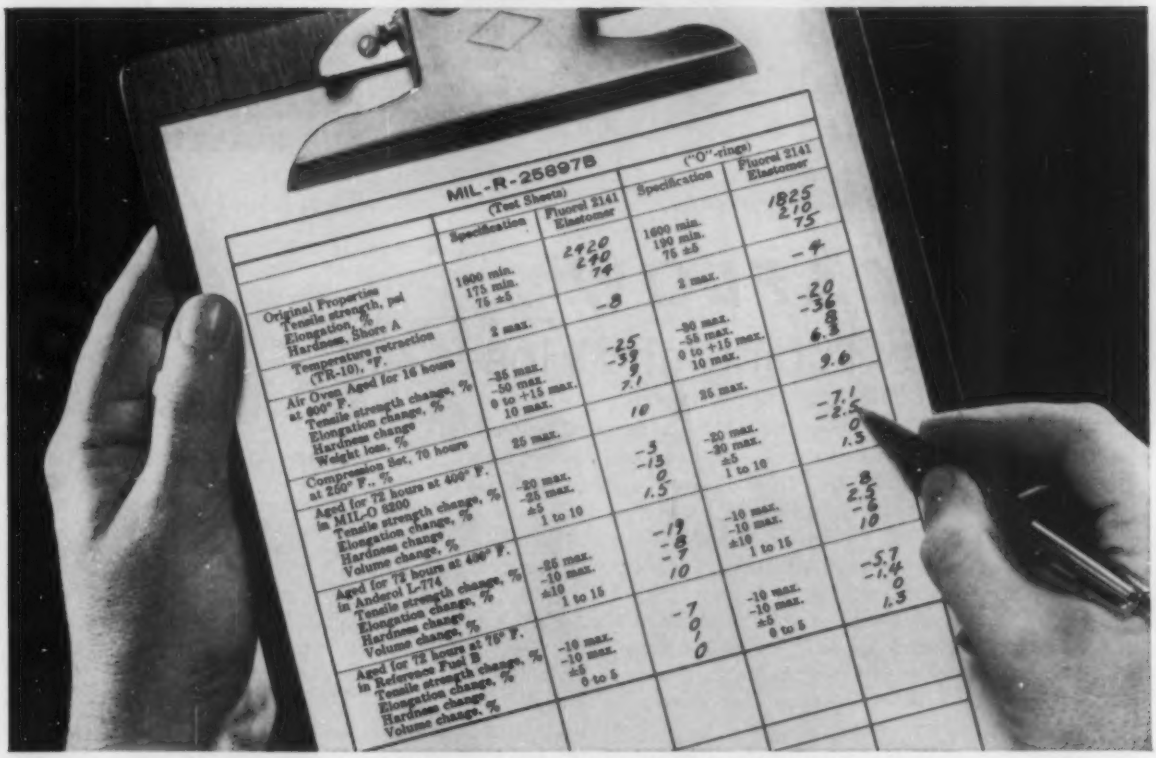


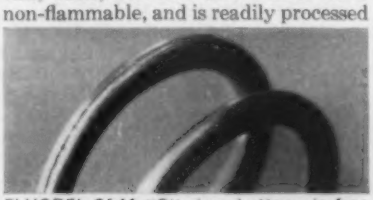
Compare FLUOREL 2141 Elastomer compound with MIL-R-25897B—Specifications above.

MIL-R-25897B quality—now available in quantity

Compounders throughout the U.S. can now supply all your needs for a maximum quality compound according to "MIL-specs" with new FLUOREL 2141 Brand Elastomer.

This new elastomer—because of its outstanding Mooney Scorch Rating, plus other qualities—provides the solution for applications where high temperatures and corrosive media prevail . . . gives you the extra margin of safety available only from a compound that can meet military specifications. Rated for continuous service at 400°F, it can withstand 600°F. temperatures, and higher, for reduced periods of time under certain service conditions.

FLUOREL 2141 Elastomer provides excellent resistance to corrosive chemicals, fuels, solvents and ozone. It is non-flammable, and is readily processed on standard rubber compounding and fabricating equipment. It may be molded, extruded and bonded to most metals . . . is finding broad application in aircraft, missile, automotive and chemical industries.



FLUOREL 2141 "O" ring, bottom, is free from defects of elastomer "O" ring, top.

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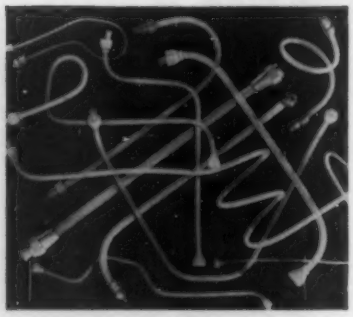

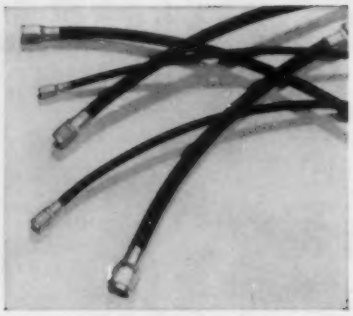

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NYLAFLOW Flexible Pressure Hose—a new, all-synthetic polyamide tube reinforced with high tensile yarn and abrasion resistant cover*—or NYLAFLOW Pressure Tubing! Both are now available from the same dependable source.

New NYLAFLOW Pressure Hose weighs only ⅕ as much as rubber of equivalent burst strength . . . and has exceptional resistance to flex and vibrational fatigue.

Unaffected by flammable and non-flammable hydraulic fluids, hydrazine and other rocket fuels, with excellent resistance to caustics and most organic solvents. Freon permeability is approximately 1/10 that of rubber hose. Excellent non-conductor for use around high voltage lines.

Odorless, non-toxic, non-corrosive, fungus resistant and will not embrittle in storage. Temperature range (—65°F. to +250°F.). Form stable and can be permanently heat-formed to small, stress-free bend radii.

Burst pressure ratings of 5000 and 8000 psi.; available in long continuous lengths in standard diameters up to ½". Compact, light-weight, reusable fittings and assemblies also available.

NYLAFLOW Pressure Tubing in sizes up to ⅜" O.D., with burst pressure ratings of 1000 and 2500 psi., is ideal for lower pressure requirements. It is flexible for easy installation and can be attached with standard flare or compression fittings designed for metallic tubing.

*Patents applied for

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The Polymer Corporation of Pennsylvania

Reading, Pa.

pitch point; point where more than one pair of teeth take all of load; last point of contact. Expressions are developed for: contact ratio; Hertzian contact stress; Hertzian contact time for all five phases of contact.

"Spur Gears—Hertzian Contact Times," Gatcombe, Kinney (U S Naval Postgraduate School), Hunnicutt (Dalmo Victor Engineering Laboratory). Lubrication Engineering, July '60, 5 N Wabash Ave, Chicago 2.

CATALOGS AND BULLETINS

To obtain copies of literature described below, circle corresponding number on postcard inside back cover.

ELECTRONIC PARTS AND EQUIPMENT—Catalog 61, 250 pp. Products of 80 manufacturers, with emphasis on electronic parts and equipment for industrial applications. Ferguson Electronics Inc, 2306 Puritan Ave, Detroit, or 4251 Stafford SW, Grand Rapids, Mich.

Circle 350 on Reader Service Card

COMMERCIAL BEARINGS—Catalog 101, 16 pp. Specifications and dimensions of 15 bearing types. Generai Bearing Co Inc, 63 Roselle St, Mineola, NY.

Circle 351 on Reader Service Card

CAPACITORS—Catalog, 22 pp. Covers catalog nomenclature and specifications, performance, ratings and descriptions of plastic film and solid tantalum electrolytic capacitors. Efcon Inc, Patterson P1, Roosevelt Field, Garden City, NY.

Circle 352 on Reader Service Card

QUICK-DISCONNECT FLUID COUPLINGS—Catalog, Section 2, 16 pp. Presents seven basic series of self-sealing, quick-disconnect fluid couplings and the particular applications of each series. Gives advantages of connectors; contains table of condensed seal recommendations for various fluids; illustrates pressure-drop curves. E B Wiggins Oil Tool Co Inc, 3424 E Olympic Blvd, Los Angeles 23.

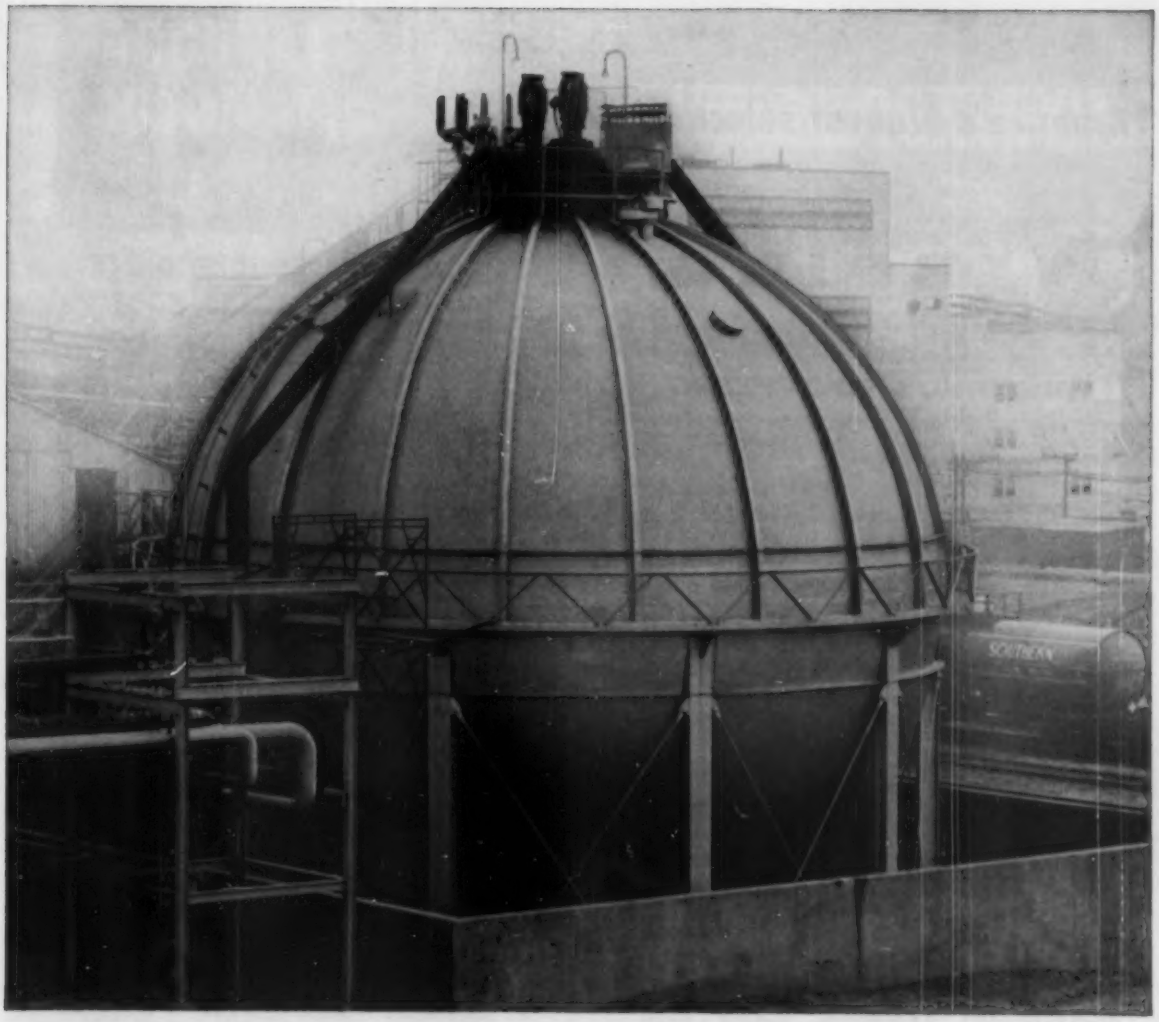
Circle 353 on Reader Service Card

HIGH-ALLOY CASTINGS—Booklet, 12 pp. Compiles list of 46 technical papers, articles, reprints and data sheets, which have resulted from Institute's informational program. Describes literature available on stainless and heat resistant castings. Alloy Casting Institute, 1001 Franklin Ave, Garden City, NY.

Circle 354 on Reader Service Card

SPECIFICATIONS AND STANDARDS FOR PRECISION SPUR GEARS—Booklet 5, 16 pp. Outlines specifications established on low inertia, custom made,

continued on page 115



2¼% nickel steel tank stores 2000 tons of liquefied chlorine at −30°F... safely

20-year service record in many installations proves this nickel steel dependable for storage of liquefied gases down to −75°F.

In two decades of service in the recommended temperature range, there has never been a single incident of field failure of any 2¼% nickel steel vessel.

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- This steel conforms to ASTM Specifications A203 (Grade B) and A300. It readily exceeds the minimum specified impact requirement of 15 ft-lb. keyhole Charpy at −75°F.
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Knowing these facts, it's easy to see why Columbia-Southern approved this material for this 2000-ton-capacity sphere. It bulk-stores chlorine at −30°F and at atmospheric pressure. Now in service 4 years, the tank fulfills every expectation of the fabricator, and of Columbia-Southern Chemical as well.

If you'd like complete data on 2¼% nickel steel, and other nickel alloy steels for service at temperatures as low as −320°F, write for your copy of "Properties of Nickel Steel Plates at Low Temperatures." Just drop a postcard to:

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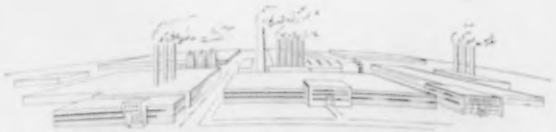

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certified military-type, fine-pitch spur gears. Also offers standard stock specification numbering system to provide broader selection of precision spur gears not ordinarily stocked by manufacturers. Covers all basic variables and utilizes standard stock gear blanks. Pic Design Corp, 477 Atlantic Ave, East Rockaway, NY.

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VARIABLE-SPEED DRIVES—Catalog MVP-101, 24 pp. Specifications and performance information on multiple-groove, variable-pitch sheaves. Browning Mfg Co, Maysville, Ky.

Circle 356 on Reader Service Card

ROOM - TEMPERATURE - VULCANIZING SILICONE RUBBERS—Bulletin S-3, 12 pp. Describes product and application information on family of room-temperature-vulcanizing silicone rubber compounds. Covers product properties and curing and viscosity characteristics. Silicone Products Dept, General Electric Co, Waterford, NY.

Circle 357 on Reader Service Card

ADHESIVES PROPERTIES — Chart. Contains information on epoxy adhesives, including their application, cure times and physical properties. Reverse side of chart contains information on test methods, application suggestions and availability. Furane Plastics Inc, 4516 Brazil St, Los Angeles 39.

Circle 358 on Reader Service Card

TFE-FLUOROCARBON SHAPES—Bulletin BR-4, 8 pp. Covers physical properties and representative applications for rod, tubing, tape and sheet. Polymer Corp of Penna, 2140 Fairmont Ave, Reading, Penna.

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PLASTIC PRODUCTS—Bulletin D400, 8 pp. Presents physical, mechanical and electrical properties and applications of the various compounds. Text is supplemented by photos showing 35 typical applications; materials-selection guide on 22 molding compounds of six different types. Hooker Chemical Corp, Durez Plastics Div, 8 Walck Rd, N Tonawanda, NY.

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DC ADJUSTABLE-SPEED DRIVE—Bulletin GEA-7019, 8 pp. Describes drive, which uses thyratron tubes to convert ac to dc power. Includes standard features and modifications. General Electric Co, Schenectady 5.

Circle 361 on Reader Service Card

GRAPHITE CLOTH—Bulletin 101, 4 pp. Property information on graphite woven fabrics and their relation to various indus-

continued on page 117

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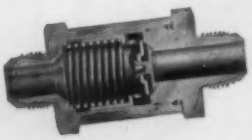

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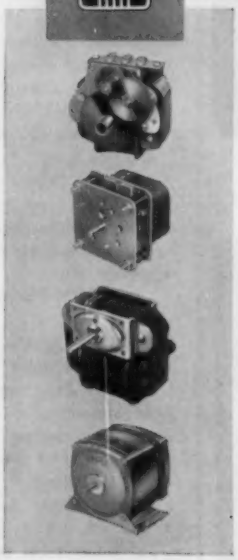

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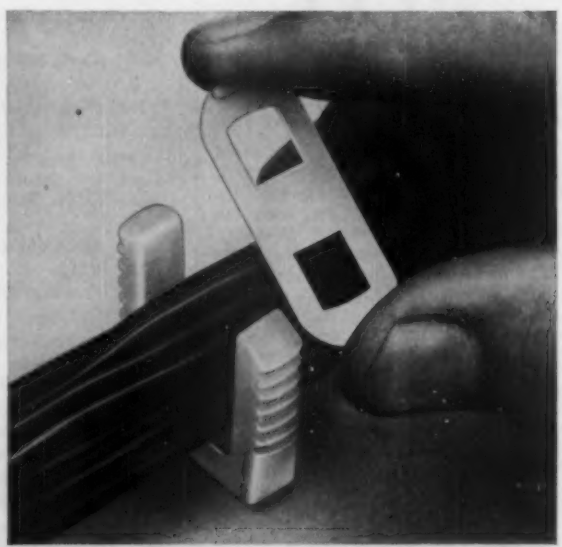

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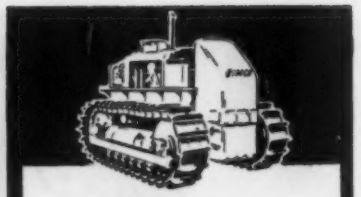

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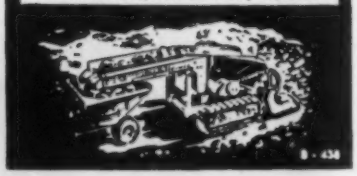

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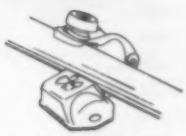

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353—Quick-disconnect Fluid Couplings, 16 pp, E B Wiggins Oil Tool Co Inc.

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369—Stock Cylinders, 4 pp, Flick-Reedy Corp, Miller Fluid Power Div.

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2	22	42	62	82	102	122	142	162	182	202	222	242	262	282	302	317	332	347	362	377
3	23	43	63	83	103	123	143	163	183	203	223	243	263	283	303	318	333	348	363	378
4	24	44	64	84	104	124	144	164	184	204	224	244	264	284	304	319	334	349	364	379
5	25	45	65	85	105	125	145	165	185	205	225	245	265	285	305	320	335	350	365	380
6	26	46	66	86	106	126	146	166	186	206	226	246	266	286	306	321	336	351	366	381
7	27	47	67	87	107	127	147	167	187	207	227	247	267	287	307	322	337	352	367	382
8	28	48	68	88	108	128	148	168	188	208	228	248	268	288	308	323	338	353	368	383
9	29	49	69	89	109	129	149	169	189	209	229	249	269	289	309	324	339	354	369	384
10	30	50	70	90	110	130	150	170	190	210	230	250	270	290	310	325	340	355	370	385
11	31	51	71	91	111	131	151	171	191	211	231	251	271	291	311	326	341	356	371	386
12	32	52	72	92	112	132	152	172	192	212	232	252	272	292	312	327	342	357	372	387
13	33	53	73	93	113	133	153	173	193	213	233	253	273	293	313	328	343	358	373	388
14	34	54	74	94	114	134	154	174	194	214	234	254	274	294	314	329	344	359	374	389
15	35	55	75	95	115	135	155	175	195	215	235	255	275	295	315	330	345	360	375	390
16	36	56	76	96	116	136	156	176	196	216	236	256	276	296						
17	37	57	77	97	117	137	157	177	197	217	237	257	277	297						
18	38	58	78	98	118	138	158	178	198	218	238	258	278	298						
19	39	59	79	99	119	139	159	179	199	219	239	259	279	299						
20	40	60	80	100	120	140	160	180	200	220	240	260	280	300						

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P51	P52	P53	P54	P55	P56	P57	P58	P59

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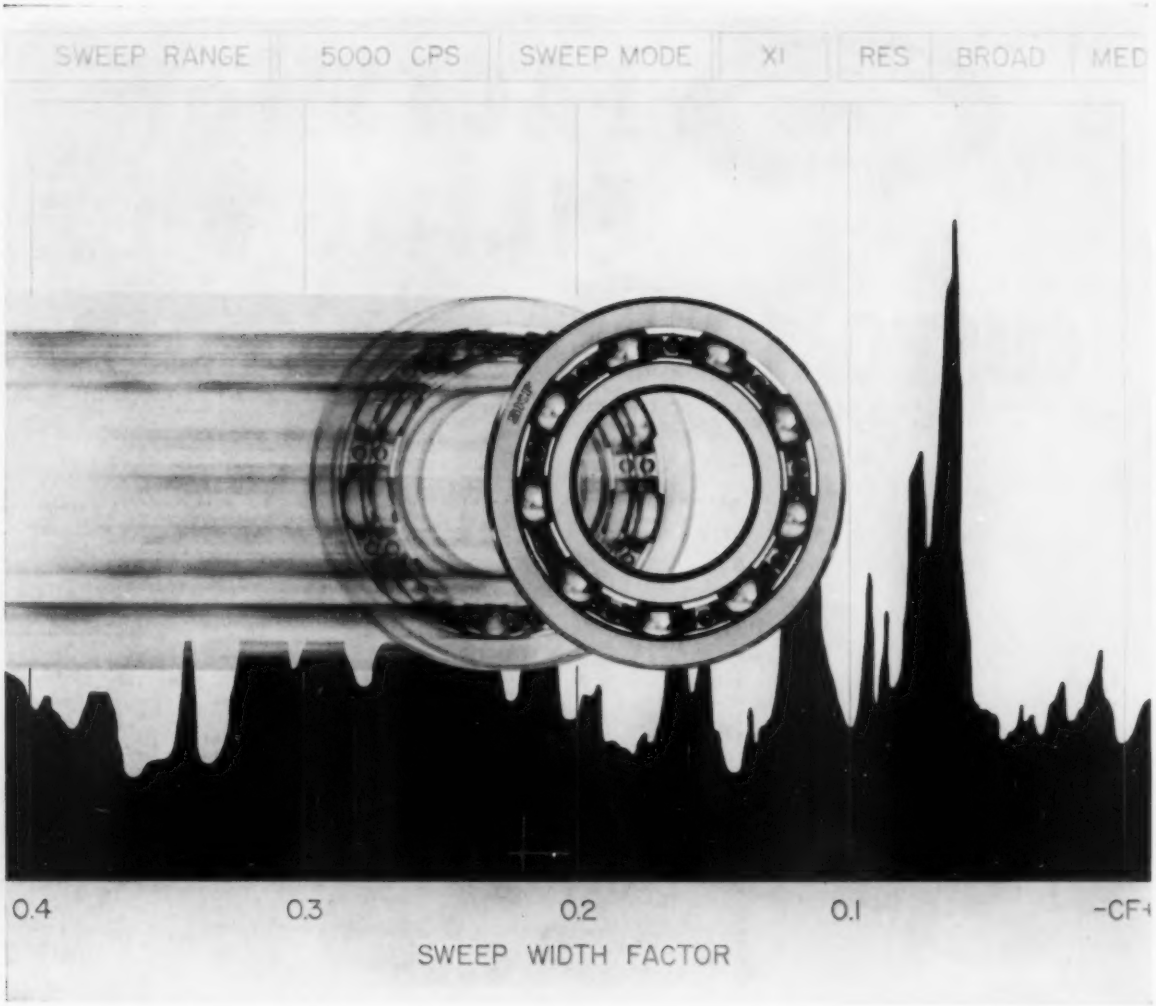

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